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## Economic Intelligence Report

# A SURVEY OF THE MACHINE TOOL INDUSTRIES OF THE SINO-SOVIET BLOC



CIA/RR ER 62-8

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CENTRAL INTELLIGENCE AGENCY  
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FOREWORD

This report discusses the types and quantities of metalcutting and metalforming machine tools produced in countries of the Sino-Soviet Bloc, foreign trade in these commodities, and recent levels of production compared with those in the US. The report is based on (1) technical journals and official statistical publications of countries of the Sino-Soviet Bloc; (2) unclassified publications of the US Government; [REDACTED]

[REDACTED] Because of the variety and complexity of these source materials, it has not been considered feasible to document the report in detail. [REDACTED]  
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A SURVEY OF THE MACHINE TOOL INDUSTRIES  
OF THE SINO-SOVIET BLOC\*

Summary

All countries of the Sino-Soviet Bloc except Albania produce machine tools. Several of these countries have well-developed machine tool industries that are strong in production of metalcutting machine tools but somewhat weaker in production of metalforming types.\*\* Many of the metalcutting machine tools produced in the Bloc, particularly in the USSR, Czechoslovakia, and East Germany, are comparable to first-line models produced in the US and in Western Europe. In production of metalforming machine tools the Bloc lags considerably behind the West, although the USSR has built a 70,000-ton hydraulic press and a 20,000-ton extrusion press, both of which are larger than any such presses built in the West.\*\*\*

In 1960 the Sino-Soviet Bloc produced about 280,000 metalcutting machine tools, of which the USSR alone produced 155,566.<sup>†</sup> By comparison, the US produced about 43,467 metalcutting machine tools.<sup>††</sup> The largest producers in the European Satellites were Czechoslovakia, East

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\* The estimates and conclusions in this report represent the best judgment of this Office as of 15 February 1962.

\*\* In this report, machine tools are classified as metalcutting or metalforming. Metalcutting machine tools are defined as power-driven machines not supported in the hands of an operator when in use, designed to remove metal in the form of chips, turnings, and borings, and include honing machines, lapping machines, grinders, and electro-erosion and ultrasonic machines. Metalforming machine tools are defined as machines, either power-driven or manually operated, but not supported in the hands of an operator when in use, designed to press, forge, emboss, hammer, extrude, blank, spin, shear, or bend metal into shape.

\*\*\* Throughout this report, tonnages are given in metric tons for the Sino-Soviet Bloc and in short tons for the US.

† Soviet production of metalcutting machine tools in 1961 was officially reported in January 1962 to have been 164,000 units, a 5-percent increase above that of 1960.

†† The US figure covers metalcutting machine tools valued at US \$1,000 or more, a category which excludes thousands of garage and home workshop types and which is believed to provide rough comparability with those produced in the USSR.

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Germany, and Poland, with production in 1960 of 24,700, 22,000, and 21,900 units, respectively. Communist China claimed production of 90,000 units in 1960, but it is estimated that only 38,000 units of significant types actually were produced. The Sino-Soviet Bloc is estimated to have produced about 50,000 metalforming machine tools in 1960, of which the USSR produced 29,900\* and East Germany 11,715.

In the USSR, about 170 plants produce machine tools, but in most of these plants this production is subsidiary to other kinds of production. About 50 plants, however, specialize in production of metalcutting machine tools and 10 in production of metalforming machine tools. Although the USSR produces a large variety of models, including approximately 1,000 type-sizes of metalcutting machine tools, the product mix is not yet adequate to meet all industrial requirements.

A high degree of standardization of machine tool components occurs in the Soviet machine tool industry. Specialization of plant production is widespread, the Gor'kiy plant, for example, specializing in milling machines and the Yegorevsk plant in gearmaking machines. The combination of standardization and specialization permits a high rate of production of the more popular models. The quality of the most recent Soviet machine tools is good, but most of the models produced are underpowered. Research in this field is already extensive and is increasing rapidly, ensuring an ample research and development base for continued improvement in the quality of the tools and in the technology of metalcutting.

The machine tool industries of the European Satellites are small in comparison with the machine tool industry of the USSR, but the machine tools produced in at least two of them, East Germany and Czechoslovakia, are modern and of good workmanship. Standardization and plant specialization in these countries are not so widespread as in the USSR, but under the influence of The Council for Mutual Economic Assistance (CEMA) the European Satellites are beginning to coordinate their production of machine tools. Most of the European Satellites are heavily engaged in research and development work on machine tools.

The machine tool industry of Communist China is a mixture of obsolescent and modern plants, the latter built by the USSR, East Germany, and Czechoslovakia. Production consists entirely of general-purpose machine tools, most of which are obsolescent by Western standards and embody only fair workmanship.

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\* Soviet production of metalforming machine tools in 1961 was reported in January 1962 to have been 30,500 units, a 2-percent increase above that of 1960.

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In their foreign trade in machine tools the countries of the Sino-Soviet Bloc deal primarily with each other, but trade with the West has been increasing. Only East Germany and Czechoslovakia are net exporters of machine tools. East Germany is the leading supplier to other countries of the Bloc, especially in metalforming machines. Czechoslovakia exports to other countries and the West, in 1960 becoming the world's third largest exporter of machine tools, surpassed only by West Germany and the US. Imports from the West consist primarily of single-purpose metalcutting machine tools. General-purpose types predominate in exports.

The USSR is a net exporter of metalcutting machine tools, with exports during 1955-59 valued at US \$207 million\* and imports at US \$174 million. In contrast, Soviet imports of metalforming machine tools far exceeded exports during the same period, with imports totaling US \$150 million and exports only US \$42 million.

In 1960, imports of machine tools by the USSR increased sharply to a level 23 percent above that of 1959. Spectacular increases occurred in imports from Switzerland, which rose 1,300 percent above 1959, and in those from West Germany, which were 166 percent above 1959. During the next few years, production of machine tools in the Bloc should continue to grow. The USSR has recently increased its goal for 1965 for output of metalcutting machine tools from 190,000 to 200,000 units to 270,000 units and has allocated additional investment for this purpose. The goal for 1965 for metalforming machines also has been increased from 36,200 units to 55,000 units, and planned investment in this sector of the industry has been tripled to provide for the increase in productive capacity. Substantial increases in production of machine tools also are scheduled for the other Bloc producers. The USSR is expected to encounter some difficulties in reaching the ambitious revised goals for production of metalcutting machine tools, but the European Satellites should have little difficulty in achieving their goals, except for Bulgaria and Rumania, whose plans appear to exceed their technical capabilities.

Qualitative improvements also can be expected. The USSR will increase sharply its output of automatic and precision types by 1965. Czechoslovakia, East Germany, and Hungary will follow suit but on a smaller scale. All prototypes of metalcutting machine tools scheduled for production in Czechoslovakia in 1965, for example, are to include built-in semiautomatic or fully automatic cycles.

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\* Unless otherwise indicated, values are in current US dollars and were obtained by converting foreign trade rubles to dollars at the rate of exchange existing at the time of the transaction. New rubles were converted at the rate of 0.9 rubles to US \$1 and old rubles at the rate of 4 rubles to US \$1.

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Although most of the Bloc production of machine tools up to 1965 will be needed for internal requirements, the combination of increased production and improved quality will place the Bloc in a better position to compete in world markets.

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## I. Introduction

Machine tools are produced in all countries of the Sino-Soviet Bloc except Albania. The USSR, Czechoslovakia, East Germany, and Poland have large and well-established industries. The machine tool industry of Hungary, although small, dates back 60 years and has a good reputation for quality. Production of machine tools in Bulgaria and Rumania is a recent development; the volume of production is small and the quality only fair. Although there was some production of machine tools in China before the Communist takeover, the quantity and range of products were small. Most of the industry in Communist China is the product of the Communist regime and was built with substantial aid from the USSR, East Germany, and Czechoslovakia. North Korea recently has built three machine tool plants, one of which is not yet completed. North Vietnam turns out a few machine tools in a plant completed in 1958 with Soviet assistance.

Production in 1960 within the Bloc is estimated at 280,000 metal-cutting machine tools and 50,000 metalforming machine tools. The following tabulation shows production of machine tools in 1960 for each producing country of the Sino-Soviet Bloc\*:

	Units	
	<u>Metalcutting Machine Tools</u>	<u>Metalforming Machine Tools</u>
USSR	155,566	29,900
Communist China	38,000**	N.A.
Czechoslovakia	24,700	5,145
East Germany	22,000	11,715
Poland	21,900	2,700
Hungary	7,500	N.A.
Rumania	4,365***	N.A.
North Korea	2,600	N.A.
Bulgaria	3,000	N.A.
North Vietnam	750	0
Total	<u>280,000</u>	<u>50,000</u>

\* Production figures   
contain a small but indeterminable number of machines that do not conform to the definitions given in the second footnote on p. 1, above. Because of rounding, components may not add to the totals shown.

\*\* Communist China reported production of 90,000 machine tools, but production of significant types is estimated to have been less than half that figure. The estimate in this tabulation is of production of types of machine tools comparable to those reported for other countries of the Sino-Soviet Bloc.

\*\*\* This figure probably includes some metalforming machine tools.

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## II. USSR

In the USSR, production of metalcutting machine tools more than doubled in the past decade, increasing from 70,600 in 1950 to 155,566 in 1960. The original goal of the Seven Year Plan (1959-65) called for production of 190,000 to 200,000 machine tools in 1965. This goal recently has been increased to 270,000, and additional investment has been allocated in an effort to expand the productive capacity of the industry sufficiently to ensure the attainment of this ambitious goal. A large share of the increased production goal for 1965 probably will consist of standardized self-contained power units for incorporation into transfer lines. Even if considerable new plant capacity becomes available in 1963 and 1964, however, the USSR will have difficulty in achieving the revised goal for 1965.

Production of metalforming machine tools more than tripled in the past decade, increasing from 9,000 in 1950 to 29,900 in 1960. The Seven Year Plan scheduled a modest increase with a planned output of 36,200 in 1965. In December 1960, however, the goal for 1965 was raised to 55,000, and planned investment in the industry for 1962-65 was tripled in comparison with that allocated for that period under the Seven Year Plan.

In the USSR, machine tools are produced by 170 plants, of which 50 specialize in metalcutting and 10 in metalforming machine tools. The total labor force engaged in production of machine tools is estimated at more than 125,000.

Most Soviet production practices parallel the conventional methods used in the West. The USSR, however, has used a higher degree of standardization of components common to many sizes of the same type of machine tool, and this standardization has facilitated the attainment of a high rate of output. Governmental and departmental standards are applied to 85 percent of the general-purpose metalcutting machine tools, and, among the metalforming machine tools, to 75 percent of the general-purpose forging machines and presses. This practice has enabled the USSR to use mass production techniques such as conveyor lines for machining parts and for assembling finished machines. The ultimate in these techniques is used at the Krasnyy Proletariy plant in Moscow, the largest Soviet producer of machine tools. This plant produces about 12,000 lathes a year, using conveyor line methods for bases, beds, headstocks, and gears, and also a moving conveyor for assembly. These lathes are model 1K62, a tool-room type with a 16-inch swing and speeds up to 2,000 revolutions per minute (see Figure 1\*). The Odessa Radial Drill Plant, using similar methods, has

\* Following on p. 7.

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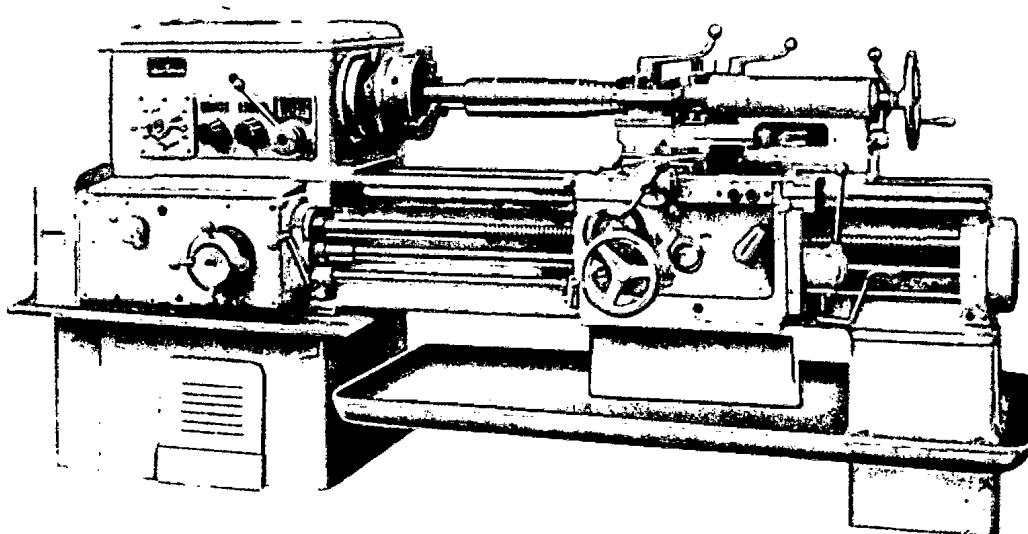
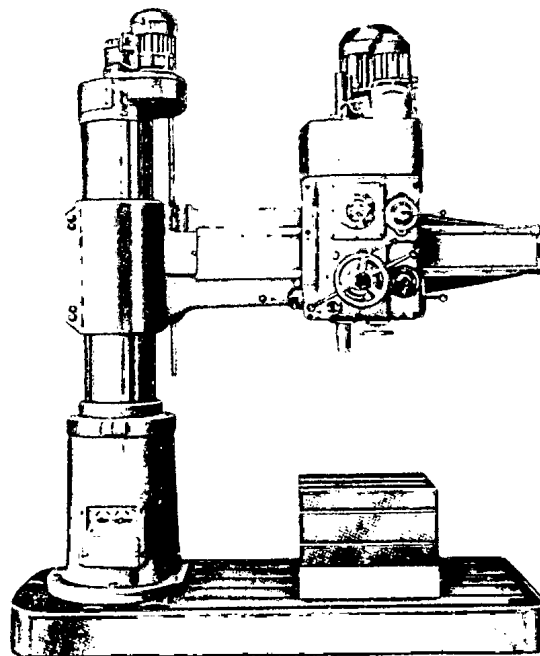


Figure 1. USSR: High-Speed Tool-Room Lathe (Model 1K62)

been producing more than 2,000 radial drilling machines annually since 1956 (see Figure 2). Other Soviet producers of engine lathes, milling machines, and upright drilling machines use similar methods but not so extensively as the two plants mentioned above.

Figure 2. USSR: Radial Drilling Machine (Model 2A55), Which Is Assembled on a Conveyor Line. This drill has a 5-foot arm and a 2-inch drill capacity.



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The various types of metalforming machine tools are produced in relatively small quantities, and Soviet authorities have not attempted to introduce conveyor techniques. In production of metalforming machine tools, however, Soviet industry appears to use steel weldments more extensively than do industries outside the Bloc. This use of weldments probably is due largely to Soviet success in developing a welding technique known as electroslog welding for use on very thick steel plates and on steel castings.

A. Comparison of Soviet and US Production

The USSR reported a production in 1960 of 155,566 metalcutting machine tools. In the same year the US, as reported by the US Bureau of the Census, produced 43,467 metalcutting machine tools of an average value of US \$1,000 or more.\* Excluding machine tools with values of less than US \$1,000 eliminates the thousands of machine tools for home workshops or garages which are produced in the US (and for which there is a very limited requirement in the USSR) and thus is believed to provide a rough comparability with the product mix of the USSR. Analysis of the Soviet models included in the Soviet production figures indicates that almost all of them would cost more than US \$1,000 in the US. The exceptions are a bench drill of which about 6,000 are produced annually in the USSR and perhaps 1,500 of the 37,000 lathes produced in the USSR in 1960. After the subtraction of these items, the ratio of Soviet production to that of the US is 3.4 to 1.

US production in 1960 does not reflect the capacity of the US machine tool industry, which has been in a depressed state for several years.\*\* Soviet production in 1960, on the other hand, is believed

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\* A total of 91,007 metalcutting machine tools each valued at less than US \$1,000 was produced in the US in 1960 for a total value of US \$19,053,000 and an average value of US \$209. Although this category is supposed to exclude tools for home workshops and garages, the low average value suggests that some of these types are included.

\*\* The peak production year in the US was 1942, when, according to data issued by the War Production Board, 307,000 metalcutting machine tools of an average value of US \$4,300 (in 1942 prices) were produced. In 1960, 134,474 metalcutting machine tools were produced in the US at an average value of US \$4,017 (in 1960 prices). Figures for both years cover machine tools of all values, including the category under US \$1,000. If average values were given in constant prices, the difference in the average values for 1942 and 1960 would be much greater. It should be noted also that production in 1942 contains a large proportion of wartime models specially designed for a high volume of production with less finish and fewer speeds and refinements than normally appear on US models.

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to be very close to the full capacity of the Soviet machine tool industry.

It is difficult to compare US and Soviet production by type because it appears to be impossible to exclude from the US production of lathes, milling machines, grinders, and vertical drilling machines the many small machine tools suitable for garages and home workshops. Table 1 shows US and Soviet production in 1959 of categories of machine tools that are not likely to include any garage or home workshop models. Although important industrially, the machine tools listed in Table 1 constitute only a small percentage of the total production of metal-cutting machine tools in either country. The comparison shows that the USSR clearly leads the US in production of all of the designated categories except boring machines.

Table 1

Comparison of US and Soviet Production  
of Selected Categories of Metalcutting Machine Tools  
1959

	Units		Ratio USSR/US
	US	USSR	
Slotters	54	497	9.2:1
Planers	40	328	8.2:1
Shapers	438	2,896	6.6:1
Radial drilling machines	596	3,518	5.9:1
Broaching machines	132	587	4.4:1
Gearmaking machines	991	3,001	3.0:1
Turret lathes	1,659	3,474	2.1:1
Automatic and semi-automatic lathes	2,064	3,512	1.7:1
Boring machines	1,604	1,052	0.7:1

Quantitative comparisons of US and Soviet production of machine tools, however, do not reflect the diversity in the product mixes of the two countries. The US produces a greater range of sizes and types than does the USSR, which has standardized on a smaller number of models. Nor do quantitative comparisons reflect the productive capacity of the machine tools built in the two countries. Comparisons of technical



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characteristics indicate that US machine tools generally are more complex, more highly automated, and more productive than similar Soviet models.\*

B. Product Mix

The product mix of metalcutting machine tools has become increasingly sophisticated in the USSR in recent years. The number of type-sizes in production increased from 384 in 1950 to 788 in 1955 and to approximately 1,000 in 1960. The Seven Year Plan calls for production of 1,500 type-sizes in 1965, including 300 type-sizes of heavy machine tools (of more than 10 tons each); 100 "precision" types; 300 automatics and semiautomatics; and 400 special, specialized, and unit types.\*\* The recent increase in the production goal for 1965, from 190,000 to 200,000 units to 270,000 units, was accompanied by a reduction in the planned number of type-sizes from 1,500 to 1,200, suggesting that the USSR expects to attain the ambitious increase in volume of production by restricting somewhat the variety of type sizes.

The upgrading of the Soviet product mix also is evidenced by changes in the volume of production of various types of machine tools. The share of lathes has decreased in the past decade from 34 percent to 24 percent of the total production, and the share of automatic and semiautomatic lathes has increased from 1 percent to 3 percent and "precision" machine tools from 3 percent to 7 percent. Soviet production of metalcutting machine tools by type for 1958-60, as reported by the Central Statistical Administration of the USSR, is shown in Table 2.\*\*\*

In the past, Soviet industry has emphasized production of heavy metalcutting machine tools -- that is, lathes for parts 10 feet in

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\* In inventory of machine tools the two countries are closer than in production. In 1958 the inventory of metalcutting machine tools in the US was 2.2 million units, in the USSR 1.9 million units. By 1960 the relative production rates probably brought the Soviet inventory up to about the US level. In 1958, there were 683,000 metalforming machine tools in the US inventory and about 450,000 in that of the USSR.

\*\* Special machine tools are those designed for machining single components; specialized machine tools are designed for machining ranges of similar items, such as grinders for crankshafts and camshafts or lathes for oilfield work and unit-type machine tools consisting of one or more self-contained power heads assembled into a combination-type or transfer-line type of machine.

\*\*\* Table 2 follows on p. 11.

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Table 2

USSR: Production of Metalcutting Machine Tools, by Category  
1958-60

	Units		
	1958	1959	1960
Total	138,290	147,574	155,566
Lathes	34,105	36,795	36,968
Turret lathes	2,986	3,474	3,583
Automatic and semiautomatic lathes	3,280	3,512	4,274
Milling machines	13,295	14,378	16,138
Gearmaking machines	2,427	3,001	3,313
Boring machines	864	1,052	1,314
Planers	480	328	433
Shapers	3,430	2,896	2,533
Slotters	677	497	733
Broaching machines	515	587	600
Grinding machines (cylindrical, external, internal, and surface grinders)	6,709	7,062	7,439
Tool and cutter grinders	3,249	3,831	4,343
Vertical drilling machines	30,367	32,228	31,769
Radial drilling machines	3,010	3,518	4,121
Special, specialized, and unit types	17,412	19,298	22,138
Other (such as sharpening, bolt-threading, and nut-tapping tools)	15,484	15,117	15,867

diameter and 90 feet long; gear hobbers for gears up to 20 feet in diameter; vertical boring mills with capacities for parts 70 feet in diameter; and roll grinders with capacities for parts 80 inches in diameter. Little attention has been given, however, to production of small precision machines, such as lathes with capacities of less than 16 inches in diameter, No. 2 mills, drills of one-half inch in diameter, planers of 48 inches in width, and one-half-inch, single-spindle automatics, and output of these items has been very meager. The current emphasis is on increasing the proportion of sizes even smaller than the above, especially precision types such as lathes similar to the Monarch 10 EE, precision drilling machines, and fine-pitch precision hobbers.

Since 1958 the USSR has built many prototypes of numerically controlled machine tools, including lathes, milling machines, drilling

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machines, horizontal and vertical boring mills, and jig borers that perform the functions of automatic positioning and two and three dimensional duplicating. Open-loop and closed-loop control circuits that are actuated by punched cards, punched tape, or magnetic tape are used in these machines. The USSR has not built so many numerically controlled machine tools as has the US. Instead, the USSR appears to be emphasizing the development of standardized control systems before going into serial production of these machine tools. In the area of electrical discharge and ultrasonic machining, the USSR has advanced rapidly, building 95 units in 1958 and 200 in 1959; 400 were planned for 1960.

There also has been considerable emphasis on production of transfer lines for the Soviet machine building and metalworking industries and on production of automatics and unit heads for incorporation into these lines. In the last few years, several new plants have been built, and at least three plants have been converted to produce this type of equipment. The Soviet machine tool industry built 160 transfer lines in 1959 and 153 in 1960. During the entire period of the Seven Year Plan, 1,722 transfer lines are to be built. The size of these lines also is increasing. In 1959 the most complicated transfer line on which information is available contained only 30 units, whereas 85 power units were used in a single line in 1960 (see Figure 3\*). Most of the newly built transfer lines are going into the motor vehicle industry, and most of the rest to the bearings, agricultural machinery, and tractor industries.

The Soviet product mix of metalforming machine tools is not adequate for the needs of the various industries. The USSR has built more than 400 type-sizes, but many are prototypes and not yet in production. Among the prototypes built in 1960 are high-speed hydraulic presses, rotary swagers, high-speed cold headers and multistation mechanical presses, all types that are principally used for production of consumer goods. These prototypes resemble Western models and are believed to be of higher quality than the earlier Soviet models.

Most of the metalforming machine tools built in the USSR are general-purpose presses (mostly mechanical), hammers, shears, and bending machines. More sophisticated types, such as those for spin-forming, stretch-wrap-forming, and others are built, but most of these are just emerging from the prototype stage.

Nevertheless, the USSR has concentrated on production of, and has built up a capacity for, large-size metalforming machine tools. The USSR has built an 8,000-ton mechanical press, a 30,000-ton forging

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\* Following on p. 13.

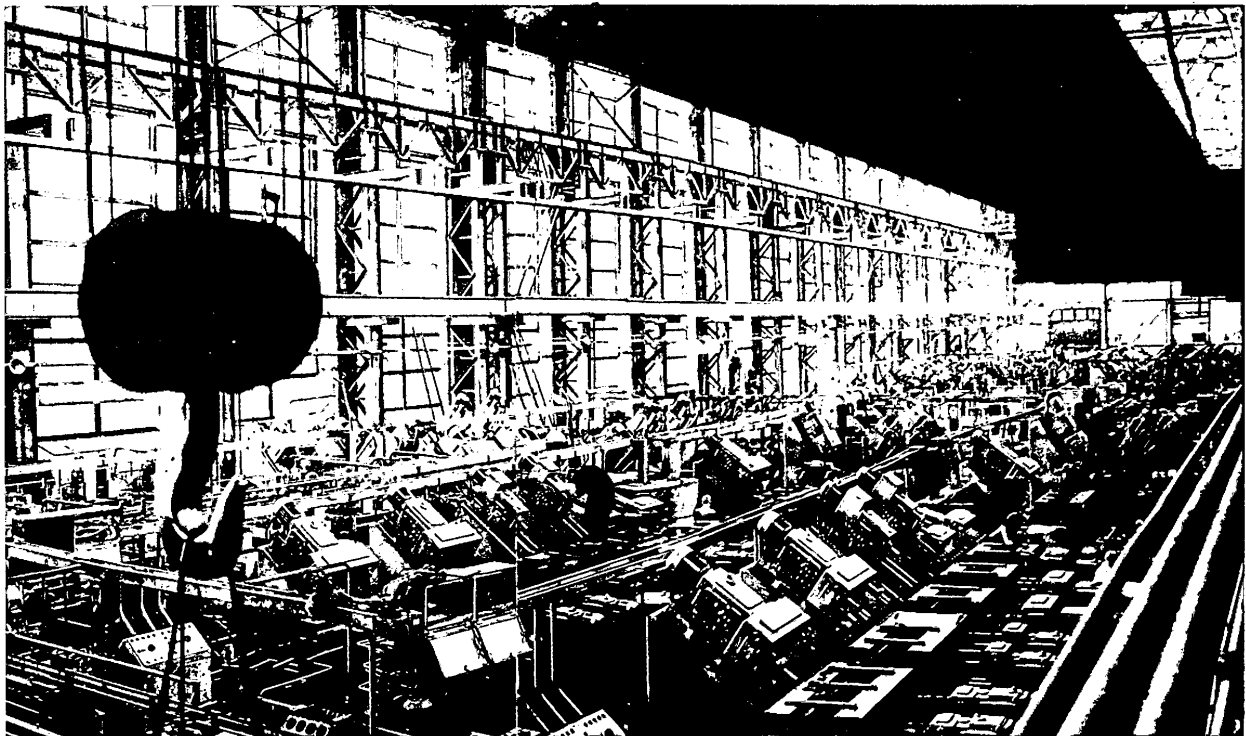


Figure 3. USSR: Assembly of Transfer Line for a V-8 Block, Which Contains 85 Power Units

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press, a 70,000-ton forging press, a 20,000-ton extrusion press, a 100-ton-meter counterblow hammer, and 6-inch horizontal forging machines.

The quality of Soviet machine tools, both metalcutting and metalforming, when compared with Western models, runs the gamut in technology and craftsmanship from obsolete to highly advanced types and from poor to very good in workmanship. Materials are good, and designs are functionally adequate. Almost all Soviet models, however, are underpowered compared with US machine tools of similar size.

C. Research

Soviet appreciation of the value of research is reflected in the central scientific research institutes, staffed with 10,000 engineers, available to the machine tool industry for solving development and production engineering problems. Most of these institutes are subordinate to the State Committee on Automation and Machine Building. In addition, 15 of the larger plants have design bureaus that supplement the central research facilities. The Experimental Scientific Research Institute for Machine Tools (ENIIMS), located in Moscow, is the central institute for the industry, with many laboratories for basic research on metalcutting machine tools. ENIIMS develops and produces prototypes, which are then assigned to other plants for quantity production. This institute has final acceptance authority for all new developments and prototypes of metalcutting machine tools originating in other institutes, plants, and design bureaus.

Basic research on metalforming machine tools and processes is carried out at the Central Scientific Research Institute of Technology and Machine Building (TsNIITMASH) in Moscow. This institute also performs basic research on other equipment and on materials for machine building plants. The emphasis in the metalforming field has been on hydraulics, especially as related to the design of heavy presses. Development of mechanical presses and forging machinery is conducted at the Experimental Scientific Research Institute for Forge and Press Machine Building (ENIIKMASH) in Moscow.

The 70,000-ton forging press and the 20,000-ton extrusion press built by the USSR probably were designed by TsNIITMASH, which also has developed a new concept of building large forging presses of more than 30,000 tons, using a large cylinder of prestressed concrete to contain the moving components (see Figure 4\*). The USSR claims that this concept will eliminate the need for building any

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\* Following on p. 15.

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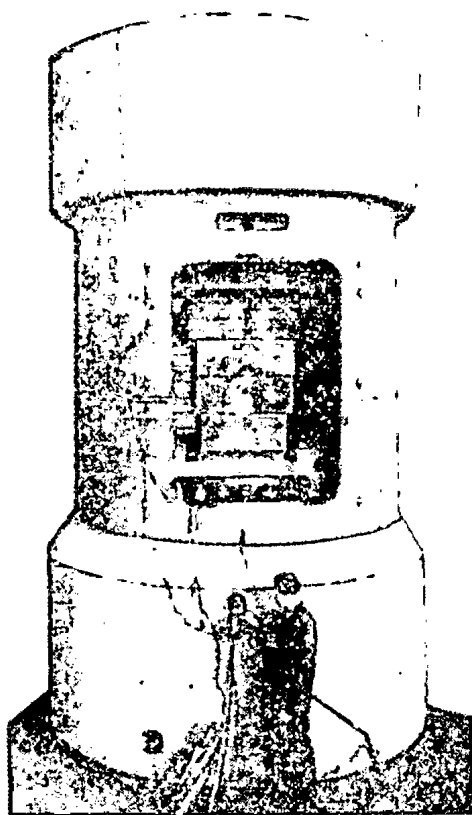


Figure 4. USSR: 15,000-Ton Press of  
Prestressed Concrete Construction

more large forging presses of conventional all-metal construction. In the US the only presses of more than 30,000 tons that were ever built were two each of 35,000 and 50,000 tons. These presses, of all-metal construction, were built for the Air Force in the mid-1950's.. Prewar Germany was the only other country ever to build a forging press as large as 30,000 tons, and this press also was of all-metal construction.

Another function of the central research institutes is to develop standards for modernizing the older machine tools or converting them to automatic cycle. In 1961 most of the research institutes of the machine tool industry were working on various projects concerning programming controls of machine tools and electrospark and ultrasonic machining.

The USSR is engaged in extensive research on various phases of high energy rate forming (HERF)\* and has had considerable success

\* The practical application of explosives, gases, electrical energy, or magnetic fields to shape metals by bending, forming, drawing, and extruding.

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in laboratory applications of this technique. There is no evidence, however, of successful application of HERF to production processes in the USSR.

#### D. Foreign Trade

The USSR is a net importer of machine tools, its position as a net exporter of metalcutting machine tools being outweighed by a large net import of metalforming machine tools. During 1955-59 the USSR imported machine tools valued at US \$324 million and exported machine tools valued at US \$250 million.

Metalforming machine tools accounted for about 45 percent of the value of Soviet imports of machine tools. The USSR imports all types of metalcutting machine tools, but precision and single-purpose types predominate. Imports of general-purpose types usually consist of "elephant" sizes. During 1955-59, approximately 90 percent by value of these imports came from the European Satellites. East Germany, Czechoslovakia, and Hungary were the three principal suppliers, furnishing 53, 25, and 10 percent, respectively, of these imports. Western countries furnished about 10 percent of Soviet imports of machine tools during 1955-59, West Germany supplying US \$10 million; the UK, US \$8 million; Italy, US \$5 million; and France, US \$2 million (see Figure 5). Imports from Austria, Switzerland, Sweden, and

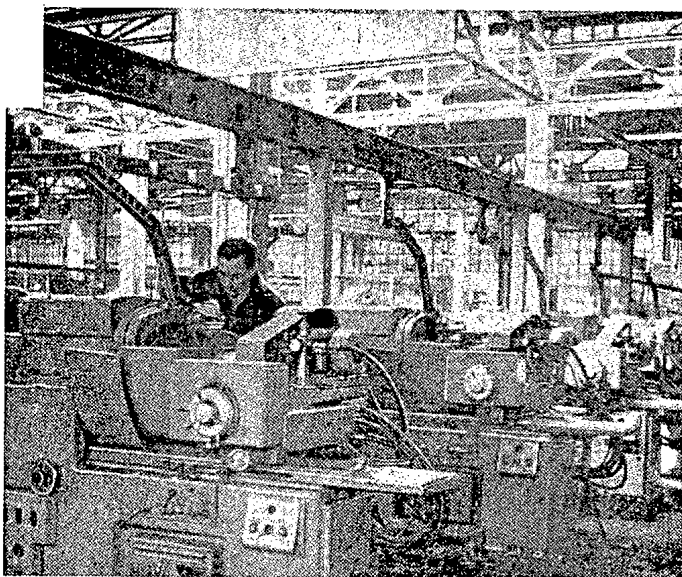


Figure 5. USSR: Western Internal Grinders Incorporated into an Automatic Line at the Minsk Bearings Plant

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other Western countries totaled US \$7 million. In 1960, Soviet imports of machine tools increased sharply to a level 23 percent above that of 1959, and the pattern of distribution changed somewhat from previous years, the European Satellites furnishing only 80 percent of the total. The most significant increases in imports from Western countries came from Switzerland, 1,300 percent above 1959, and West Germany, 166 percent above 1959.\*

Although it is estimated that the USSR exported machine tools valued at US \$250 million during 1955-59, the Soviet trade handbooks show exports of machine tools valued at only US \$68 million for that period. Most of the exports of machine tools during 1955-59, estimated in the amount of US \$181 million, were contained in a more general category, "exports of equipment for complete plants." The volume of these exports has been reported in other Soviet published sources in terms of units, and their value has been estimated for the purposes of this report. There is no direct information, however, on the geographical distribution of machine tools exported as part of complete plants, and the following remarks apply only to those exports which are designated as machine tools in the Soviet trade handbooks. From what is known of the pattern of Soviet exports of complete plants, however, it is believed that the relative position of the receiving countries, except for Czechoslovakia, would be about the same.

During 1955-59, about 80 percent of Soviet exports of machine tools, by value, went to other Bloc countries. Communist China was the largest single customer, receiving about 40 percent of the total, or the same amount exported to all the European Satellites. Czechoslovakia, Hungary, and Poland were the largest European Satellite importers, receiving 11, 9, and 8 percent, respectively, during 1955-59. Imports by Hungary rose from less than 2 percent in 1955 to 17 percent in 1959. Imports by Poland fell off from 30 percent in 1955 to 4 percent in 1959.

\* The sharp increase in imports from Switzerland reflects deliveries on orders placed at least 18 to 24 months earlier. Switzerland operates with backlogs of 18 to 36 months depending on the type of equipment on order. The USSR usually imports jig borers, gear machinery, and precision lathes from Switzerland. In absolute terms, Soviet imports of metalcutting machine tools from Switzerland increased from 48 units valued at US \$452,000 in 1959 to 696 units valued at US \$6,202,000 in 1960. Imports of metalforming machine tools from Switzerland in 1960 amounted to US \$119,000. Imports of metalcutting machine tools from West Germany increased from 138 units valued at US \$1,817,000 in 1959 to 840 units valued at US \$5,583,000 in 1960. The value of Soviet imports of metalforming machine tools from West Germany increased from US \$1,715,000 in 1959 to US \$3,803,000 in 1960.



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The share of Soviet exports of machine tools received by the underdeveloped nations rose from less than 4 percent in 1955 to more than 16 percent in 1959. Egypt and India are the principal consumers among the underdeveloped nations. Soviet exports of machine tools to the West increased gradually during 1955-59, amounting to about US \$3 million in 1959. In 1960, over-all Soviet exports of machine tools declined 9 percent from 1959.

During 1955-59 the USSR exported metalcutting machine tools with an estimated value of US \$207 million and imported metalcutting machine tools valued at US \$174 million. In terms of units, 26,000 of these tools are estimated to have been exported and 18,000 imported. These quantities are equivalent to 4 and 3 percent, respectively, of Soviet domestic production during 1955-59. Annual exports increased from 4,100 in 1955 to 7,100 in 1960. Annual imports tripled during the same period, increasing from 2,400 in 1955 to 7,600 in 1960.

Soviet trade in metalforming machine tools during 1955-59 showed a considerably different pattern, with imports totaling US \$150 million and exports only US \$42 million. Both imports and exports increased steadily during this period, imports rising from US \$23 million in 1955 to US \$38 million in 1960 and exports as reported in Soviet trade handbooks from US \$2 million in 1955 to US \$5 million in 1960.

III. Production in the European Satellites

A. General

All of the European Satellites except Albania produce metalcutting machine tools. The quality is generally good, and production is large, totaling 83,500 units in 1960, or 54 percent of production in the USSR. Production of metalforming machine tools in 1960 was about 20,000 units, or two-thirds of that in the USSR. East Germany and Czechoslovakia, the leading producers, build nearly a full range of machine tools. The other four countries -- Poland, Hungary, Rumania, and Bulgaria -- produce a limited range, mainly general-purpose types.

B. East Germany

East Germany ranks second among the European Satellites in volume of production of metalcutting machine tools and first in volume of production of metalforming machine tools. Production in 1960 of 22,000 metalcutting\* and 11,715 metalforming machine tools was a considerable

\* This is a minimum figure. Several types of machines known to be in production in East Germany are not included in the official breakdown of production of machine tools.

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increase above that of 1950, when about 13,450 metalcutting and 4,124 metalforming machine tools were built, but was still less than production in 1938 of 38,000 metalcutting and 17,000 metalforming machine tools in the area that now constitutes East Germany.

East Germany produces a wider range of models of both metalcutting and metalforming machine tools than any other European Satellite. Before 1957, most machine tools produced in East Germany were obsolete World War II models. Since 1957, however, there has been rapid improvement in machine tool designs. Many current models are comparable in quality with those produced in Western Europe, and a few even surpass Western European models. In 1960 the East Germans claimed that 47 percent of their machine tools were up to world standards. East Germany ranks close to Czechoslovakia in the quality of machine tools produced.

In production of metalcutting machine tools, East Germany specializes in jig borers, gearmaking machinery, and grinding machines. East Germany is the leading Bloc supplier of jig borers, producing machines of average quality of both the Lindner (West Germany) and the SIP (Switzerland) types (see Figure 6). The gearmaking machines produced are notable for their large size (see Figure 7), some gear-hobbing models handling gears up to 20 feet in

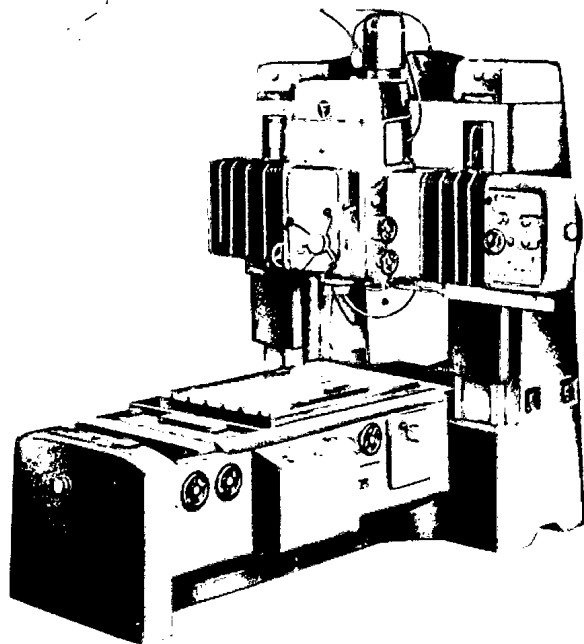


Figure 6. East Germany: Latest  
Jig Borer (SIP Type)

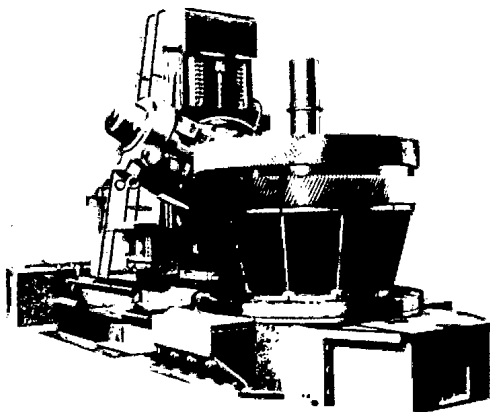


Figure 7. East Germany: Gear  
Hobber for Making Gears up to  
10 Feet in Diameter

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diameter, but they are not comparable with Czechoslovak or British (David Brown) models in modernity of design. Production of medium-size vertical boring mills, with tables more than 8 feet in diameter (see Figure 8), is greater than in any other Bloc country. Most of

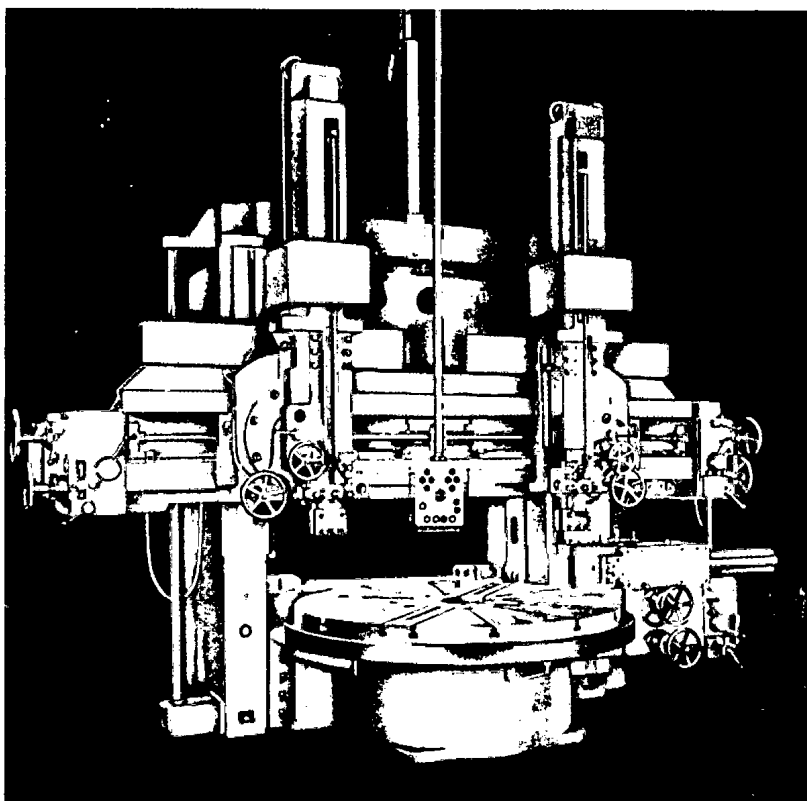


Figure 8. East Germany: Vertical Boring Mill  
Built in Sizes up to 20-Foot Turning Diameter

these mills go to the USSR. A few models of East German milling machines are highly automated and appear to be superior in design to similar types produced in Western Europe.

East Germany is producing some models of program-controlled machine tools, which are of the mechanical and electric preselection types. The industry appears to have done little in the area of numerical controls, all models of this type being still in the prototype stage. Increasing emphasis is being placed on production of standardized self-contained power heads and other components for incorporation into automatic transfer lines, but this development is still on a small scale.

In production of metalforming machine tools, East Germany is the largest builder in the Bloc of large-size mechanical presses of more than

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500 tons pressure and of large counterblow hammers of 40 ton-meters and more. East Germany has built one 6,000-ton forging press, the largest size that can be turned out in the existing metalforming machine tool plants of East Germany.

About 90 plants, 50 of them state-owned and 40 privately owned, are engaged in production of machine tools. The industry employs about 37,000 people. Approximately 75 percent of the metalcutting machine tools are produced in Leipzig, Chemnitz (Karl-Marx-Stadt), and Dresden. East Berlin, with three machine tool plants, is noted for its production of large gear hobbers and vertical boring mills with tables up to 20 feet in diameter. About 95 percent of the metalforming machine tools are produced in the seven southernmost districts of East Germany. More than one-third of the medium-size and large-size mechanical presses (see Figures 9, 10, and 11\*) and large metalcutting shears are produced by the Henry Pels Plant in Erfurt.

East German production processes in the machine tool industry are not conveyORIZED. Usually, machine tools are produced in batches of 10 units or less, or they are custom-built. Research related to machine tools is carried out by the Institut fuer Werkzeugmaschinen in Chemnitz (Karl-Marx-Stadt). This institute is responsible for developing annual and long-range plans for research in machine tools and development of new models and also for establishing standardization in the machine tool industry. It also represents East German interests in machine tools in the permanent commission for machine building of CEMA.

Future plans of the industry call for a considerable increase in production of machine tools. Production of metalcutting machine tools, for example, is to increase in value from 652 million DME\*\* in 1961 to 1,128 million DME in 1965. Plans for upgrading the product mix specify that 90 percent of the machine tools produced in 1965 (this percentage presumably refers to models rather than to the volume of production) are to be equal to "world standards," compared with only 47 percent in 1960.

East Germany is a net exporter of machine tools and is the leading supplier to Bloc countries, especially of metalforming machines. In 1959, East Germany exported machine tools valued at US \$44 million to its largest customer, the USSR. Exports to West Germany, the most significant non-Bloc customer, totaled US \$3.3 million in 1959.

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\* Following on p. 22.

\*\* Deutsche Mark East (East German marks) may be converted to US dollars at the official rate of exchange of 4.2 DME to US \$1.

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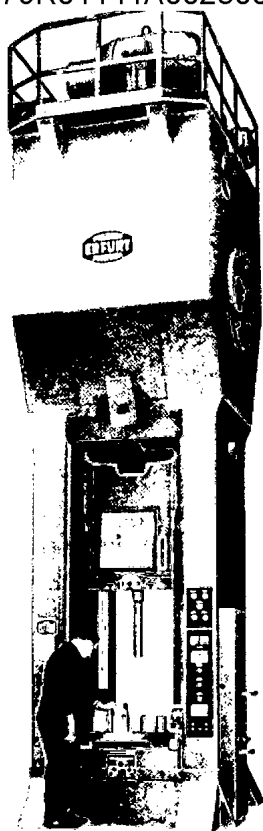


Figure 9. East Germany: 200-Ton Straight-Side  
Crank Press Built at the Henry Pels Plant in  
Erfurt

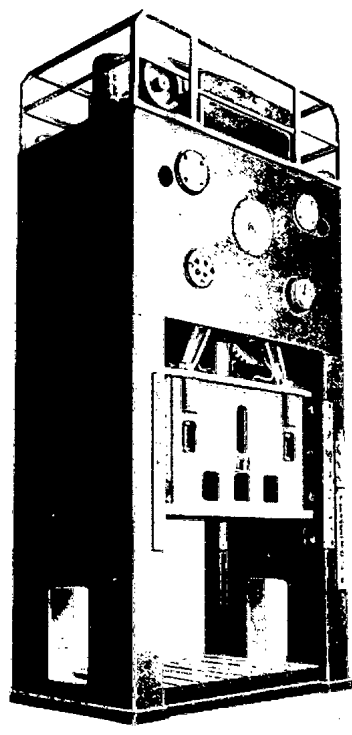
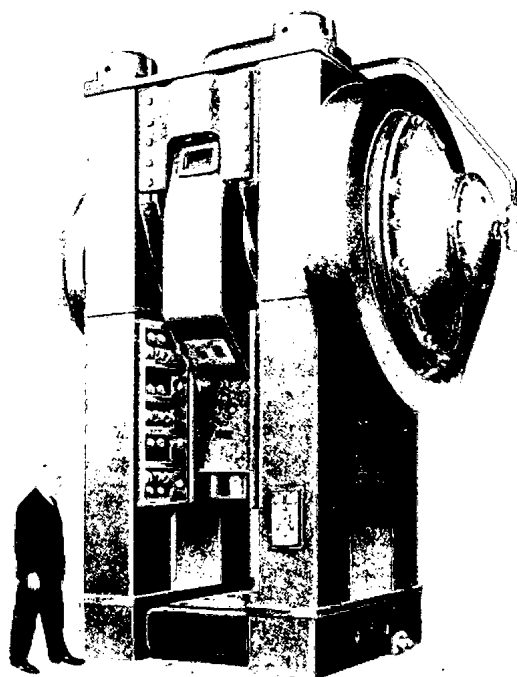


Figure 10. East Germany:  
400-Ton Two-Point Toggle  
Press Built at the Henry  
Pels Plant in Erfurt

Figure 11. East Germany: 2,500-Ton Crank  
Press for Hot Forging Built at the Henry  
Pels Plant in Erfurt



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East German imports of machine tools are small in number but are qualitatively significant. Czechoslovakia was the principal Bloc supplier in 1959 and in that year exported to East Germany tools valued at US \$4.6 million. During 1955-59 the principal non-Bloc suppliers of machine tools to East Germany were West Germany and Switzerland, with exports in 1959 valued at US \$2 million and US \$900,000, respectively.

### C. Czechoslovakia

Among the European Satellites, Czechoslovakia shares with East Germany the leading position in machine tool production. In 1960 the Czechoslovak machine tool industry produced 24,700 metalcutting and 5,145 metalforming machine tools. Production of machine tools is sufficiently large and diversified to satisfy most domestic requirements. Imports consist of special-purpose and high-precision metalcutting machine tools that are not manufactured domestically or are manufactured in inadequate numbers. The quality of the machine tools produced in Czechoslovakia is the highest in the Sino-Soviet Bloc; many models are advanced in design and, in general, compare favorably with similar models manufactured in Western Europe.

Most of the 400 models of metalcutting machine tools produced in Czechoslovakia are general-purpose, semiautomatic machines designed for medium-duty service. The industry specializes in engine and turret lathes and radial drilling machines, usually of small and medium sizes (see Figures 12, 13, and 14\*), but large machine tools, such as planers 8 feet wide and vertical boring mills with a 40-foot swing, also are built on order.

The industry builds relatively few models of metalforming machine tools, and most of these are of small or medium sizes. Although the actual production of large-size machine tools is numerically small, Czechoslovakia is capable of manufacturing larger hydraulic forging and extruding presses than any other European Satellite and has already built a 12,000-ton hydraulic forging press for domestic use (see Figure 15\*\*).

The current emphasis is on improving the precision of the models, on standardizing attachments in order to increase the flexibility of the general-purpose machine tools, and on replacing obsolete models with more complex automatic or semiautomatic types. Standardization of self-contained power units to minimize the number of sizes needed for setting up automatic transfer lines is being stressed. All prototypes of metalcutting machine tools scheduled for production by 1965 include built-in\*\*\*

\* Following on p. 24.

\*\* Following on p. 25.

\*\*\* Text continued on p. 26.

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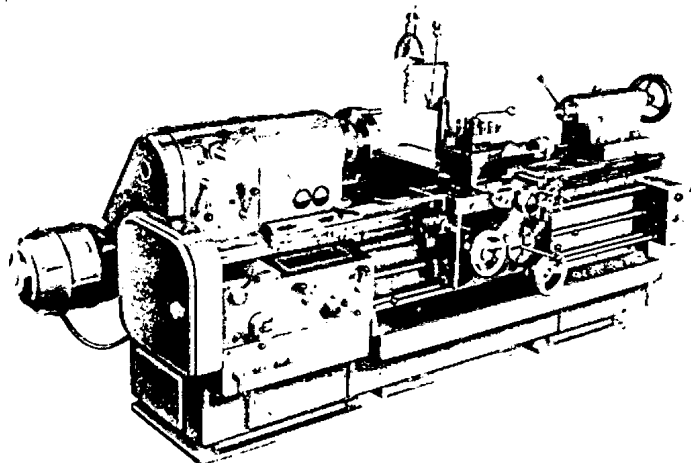


Figure 12. Czechoslovakia: Engine Lathe with an 18-Inch Swing by 40-Inch Centers

Figure 13. Czechoslovakia: Turret Lathe (Saddle Type, 3-Inch Bar)

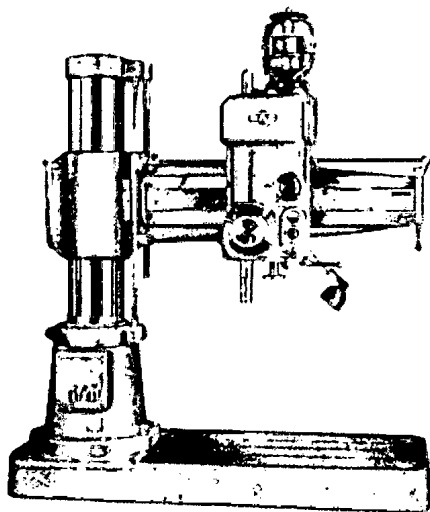
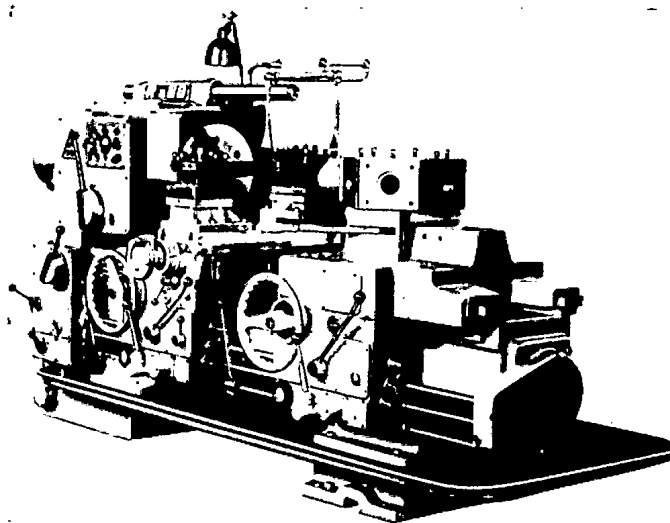


Figure 14. Czechoslovakia: Radial Drilling Machine with a 4-Foot Arm and a 2-Inch Drill Capacity

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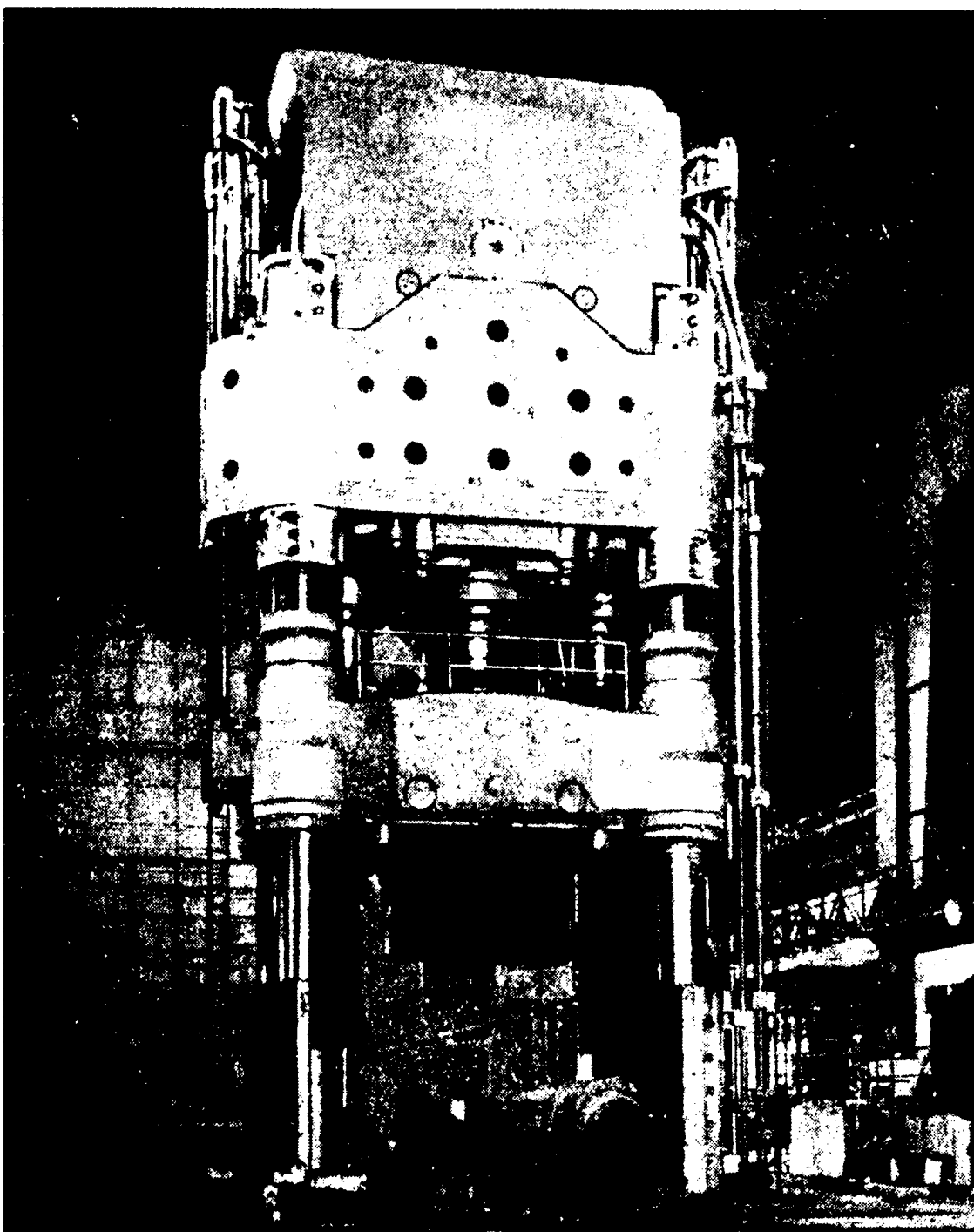


Figure 15. Czechoslovakia: 12,000-Ton Hydraulic Forging Press

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semiautomatic or fully automatic cycles, achieved through the use of electromechanical or electrohydraulic devices. Also being designed are models that will include automatic cutting cycles, automatic positioning, and continuous contouring, controlled by means of punched cards or punched tape.

Czechoslovakia has 21 important state machine tool plants that in 1959 accounted for the manufacture of about 80 percent of the total output of machine tools in terms of units and probably more than 90 percent in terms of value. The remaining production occurs in a much larger number of state plants that contribute only a small part of the total output, either because of their small size or because machine tools form only a minor part of their production.\* Except for two plants in Slovakia, all of the principal machine tool producers are located in Bohemia and Moravia, where 84 percent of the metalcutting and 75 percent of the metalforming machines are produced. In Czechoslovakia the machining of machine tool parts and the assembly of the machines themselves are accomplished in batch lots rather than on conveyor lines.

All Czechoslovak production of machine tools is under the administrative control of the Ministry of Heavy Machine Building. The important enterprises engaged in production of metalcutting machine tools are associated in the Machine Tool and Tool Works, Association of National Enterprises (Tovarny na Obrabeci Stroje a Naradi Sdruzeni Narodnich Podniku -- TOS), which was formed under the Ministry of Heavy Machine Building at the time of the industrial reorganization of 1958.\*\* Production of metalforming machine tools takes place primarily in five heavy machine building plants administered directly by the Ministry of Heavy Machine Building.

The major machine tool plants are highly specialized. TOS Celakovice in Celakovice, for example, produces all Czechoslovak gear-cutting and grinding machinery; TOS Hostivar in Prague produces grinding machines of all types; TOS Kovosvit in Sezimovo Usti specializes in radial drilling machines; TOS Svitavy in Svitavy specializes in sensitive drilling machines; and TOS Kurim in Kurim specializes in milling machines. Very large lathes, boring mills, and pressing equipment

\* In addition, small machine tools such as bench grinders, bench drill presses, and twist drill sharpeners, used primarily for repair and maintenance operations, are manufactured in substantial numbers by producer cooperatives.

\*\* TOS also directs production of metalcutting machine tools of plants that are not members of the Association, as well as production of shoe and leather-working machinery, woodworking machinery, and various types of tools, measuring instruments, and grinding devices.

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usually are produced in heavy machine building plants such as ZVIL in Plzen and CKD Blansko in Blansko, which, although not engaged primarily in production of machine tools, are able to produce machine tools so large as to exceed the manufacturing capabilities of ordinary machine tool plants.

Research and development is performed by two institutes: Vyzkumny Ustav Obrabecich Stroju a Obrabeni -- VUOSO (Research Institute for Machine Tools and Machining), which has its main office at Prague, and Vyzkumny Ustav Tvarecich Stroju a Technologie Tvareni (Forming Machinery and Technology Research Institute), which is attached to the principal metalforming machine tool plant, Bohumir Smeral, at Brno.

In 1960, Czechoslovakia became the world's third largest exporter of machine tools, having advanced from its position as fifth in 1957, and is now exceeded in this respect only by West Germany and the US. In 1960, exports accounted for about 46 percent of Czechoslovakia's unit output of machine tools.

Most Czechoslovak exports of metalcutting tools are general-purpose types in small and medium sizes. Some large machines have been exported, especially vertical boring mills with swings of up to 41 feet (see Figure 16\*), horizontal boring mills with 8-inch or 10-inch spindles, and large turning lathes with 10-foot swing and 50-foot centers. Except for a few large machines, including a 27-foot bending roll and 3,000-ton and 6,000-ton forging presses, exports of metalforming tools have been small and have consisted mostly of presses rated at less than 100 tons. Czechoslovakia has contracted, however, to build two 12,000-ton forging presses, one for India and one for Communist China.

Fewer than 10 percent of the machine tools added to the Czechoslovak machine tool inventory during 1957-59 were imported. Current imports consist mainly of precision and special-purpose metalcutting types, such as honing, lapping, broaching, jig-boring, and gearmaking machines that are not produced domestically or are produced only in small quantities. Most of these imports are machines of small sizes, but a few large forging hammers, drop and counterblow hammers, mechanical presses of more than 500 tons pressure, and large shears are included.

Bloc countries are providing an increasing share of Czechoslovak imports of machine tools, having furnished 65 percent of the total number imported by Czechoslovakia in 1957 and 86 percent in 1959. East Germany, the principal supplier, provided nearly 50 percent of the total number of machine tools imported by Czechoslovakia in 1958 and about 75 percent in 1959.

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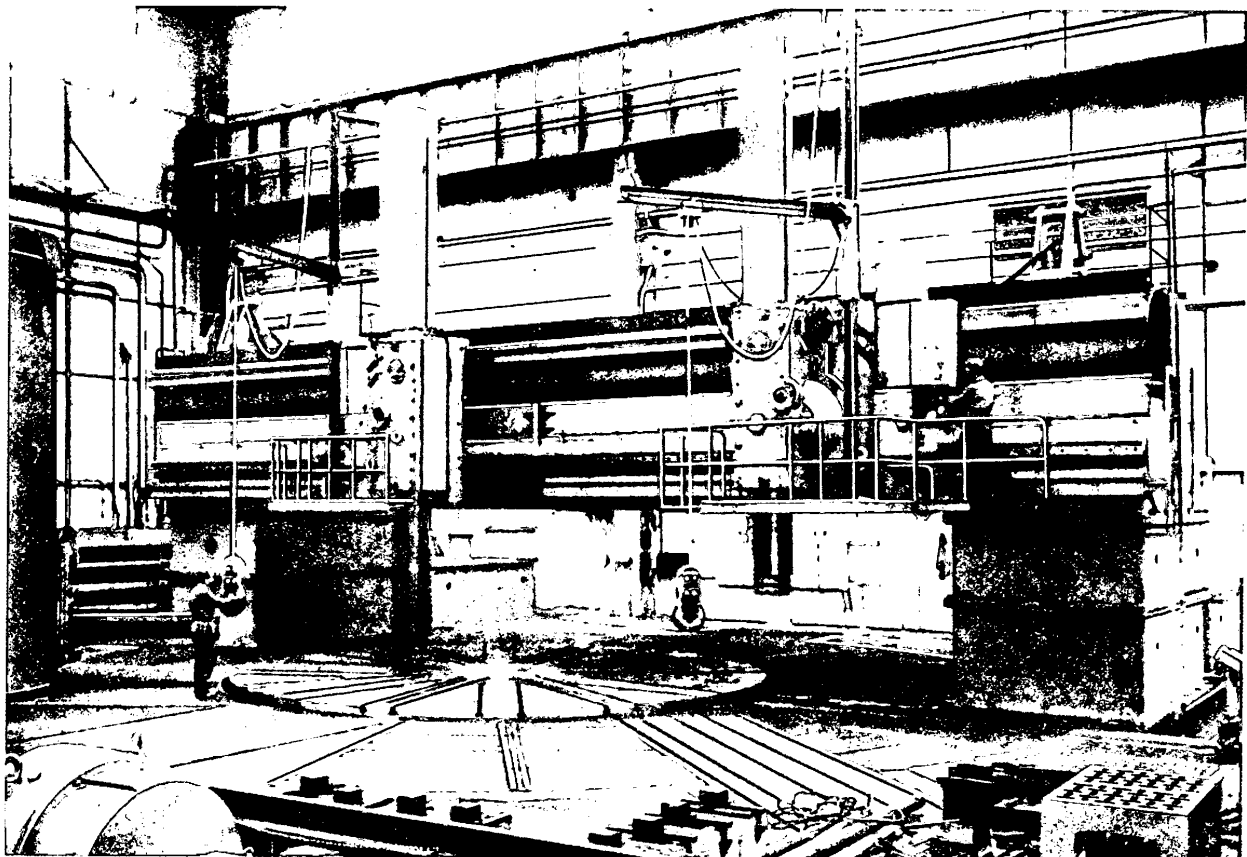


Figure 16. Czechoslovakia: Special Light-Duty Type of Vertical Boring Mill Built for Export

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Imports from the West are highly selective, being composed of machine tools of a precision and quality that cannot be obtained from other Bloc countries. Switzerland and West Germany have been the chief non-Bloc suppliers, providing 35 and 26 percent, respectively, of the total number of machine tools obtained in 1959 from the West. Switzerland has supplied mainly gearmaking machines and copying lathes, and West Germany has provided special-purpose metalcutting machines.

D. Poland

Poland, with a production in 1960 of 21,900 metalcutting and 2,700 metalforming machine tools, ranks after East Germany and Czechoslovakia among the European Satellite producers. Poland produces 200 models of metalcutting machine tools and specializes in production of single-purpose machine tools for steel mills and for production and maintenance of railroad equipment (see Figures 17 and 18). Production

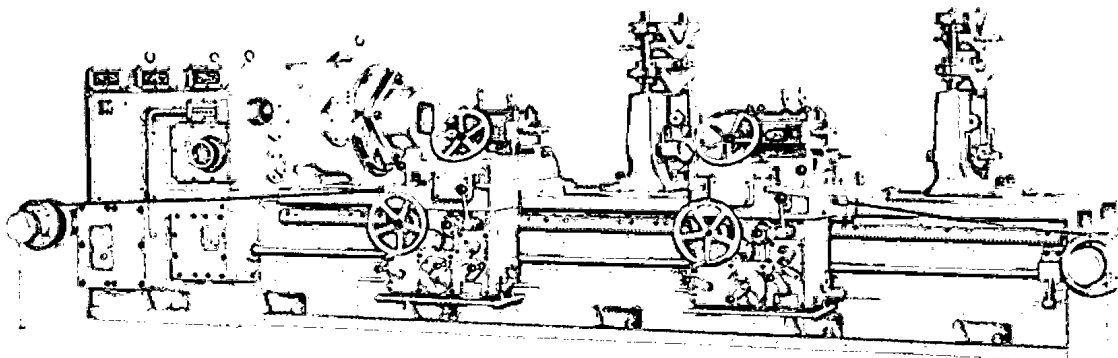


Figure 17. Poland: Roll Turning Lathe for Making Steel Mill Rolls

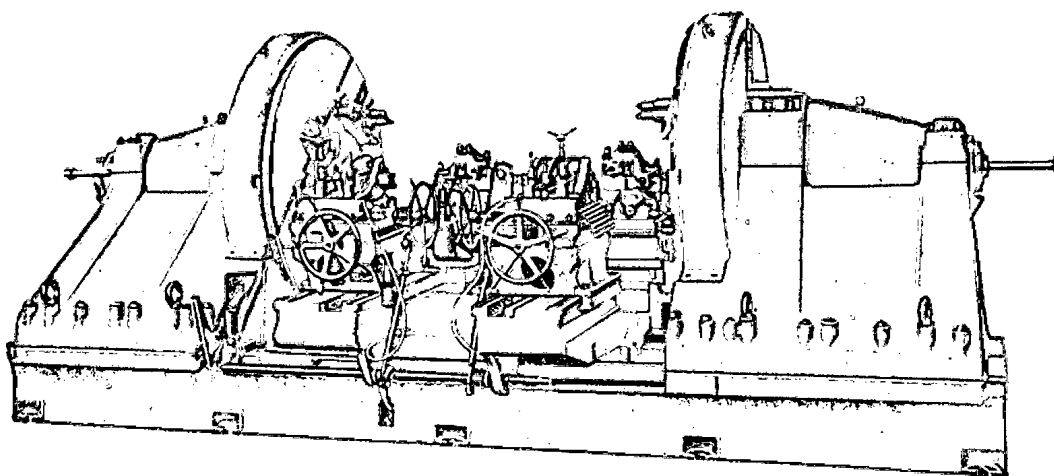


Figure 18. Poland: Semiautomatic Wheel Lathe for Making Locomotive and Tender Wheel-Sets

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of general-purpose metalcutting machine tools is limited to lathes, drilling machines, milling machines, grinders, and planers. In the field of metalforming machine tools, Poland produces 100 models and specializes in drop hammers in sizes up to 10 tons falling weight. Production of other metalforming machines is limited to mechanical presses in sizes up to 300 tons pressure and a few models of guillotine shears and other types of shears. The workmanship in Polish machine tools is good, but the designs, except for a few current prototypes, are mostly obsolescent.

Poland has 35 plants that are significant producers of machine tools. Twenty-five of these are located in the Warsaw-Wroclaw-Krakow triangle. Heavy machine tools are produced in the Katowice district of Upper Silesia. About 20,000 persons are employed in the industry.

Production of machine tools in Poland is under the supervision of the Central Union of the Machine Tool Industry (Centralny Zarnad Przemyslu Obrabiarek -- CZPO), which is controlled by the Ministry of Heavy Industry. More than 80 percent of the machine tools are produced in plants under the control of the CZPO. Additional producers include plants controlled by other central administrations of the same ministry and state and cooperative enterprises under the Ministry of Small Scale Industry and Crafts.

The principal institute for basic research in the Polish machine tool industry is the Institute of Machine Tools and Cutting Processes (Instytut Obrabiarek i Obrobki Skrawaniem -- IOOS) in Krakow. In collaboration with technical colleges, this institute studies Soviet Bloc and Western techniques of machine tool building and maintains technical information posts at metalworking machinery plants for dissemination of information concerning foreign technical developments. Research in electroerosion and ultrasonic machining is carried on in this institute.

The Central Design Office for Machine Tools (Centralne Biuro Konstrukcyjne Obrabiarek -- CBKO) in Pruszkow is responsible for the design and development of prototypes of metalcutting machine tools, which are built at the experimental plant of CBKO. Prototypes of presses and hammers are designed and built by the Central Bureau for Construction of Presses and Hammers (Centralne Biuro Konstrukcyjne Pras i Mlotow) in Warsaw. Laboratories in individual plants also carry out research and development in this field.

Poland is a net importer of machine tools, purchases from abroad consisting largely of high-precision machine tools not produced domestically. Bloc countries provided 68 percent of the Polish imports in terms of value in 1959 with Czechoslovakia supplying 32 percent and East Germany

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28 percent. West Germany has been the major supplier from the West and has increased annual shipments from a total value of US \$200,000 in 1956 to US \$1.5 million in 1959. In 1959, Poland also received machine tools valued at US \$900,000 from Italy, US \$750,000 from the UK, and US \$600,000 from the US.

Poland exports, mostly to the Bloc, general-purpose lathes, lathes for turning wheel sets for railroad locomotives and cars, boring and turning mills, milling machines, and grinders. Forging hammers, presses, and shears are exported in small quantities. In 1959 the Bloc received 71 percent of the value of all Polish machine tool exports. Of this percentage, Communist China received 30 percent and the USSR 19 percent. The largest export to a non-Communist country in 1959 went to India, which received machine tools valued at US \$600,000. The two largest West European customers for Polish machine tools in 1959 were Italy and West Germany with imports valued at US \$246,000 and US \$159,000, respectively.

E. Hungary

Hungary is a small producer of machine tools, ranking sixth among Sino-Soviet Bloc manufacturers and turning out about one-third as many metalcutting machine tools as Czechoslovakia, East Germany, or Poland. Few metalforming machine tools are produced in Hungary. Of the total quantity of metalcutting machine tools produced, 40 percent are upright and radial drilling machines, 35 percent are engine lathes, and 15 percent are knee-type milling machines (see Figures 19, 20, and 21\*). Most of the machines produced are light-duty types usually lacking in advanced technological refinements. Workmanship is fair but improving rapidly. About two-thirds of the total production is sold abroad, mostly to Bloc countries.

Although there are 14 plants that are administratively part of the machine tool industry, 5 of these plants assemble about 90 percent of the total number of machine tools. Three of these -- Femaru es Szerszamgepgyar, Kobanyai Szerszamgepgyar, and Matyas Rakosi Muvek -- are located in Budapest; the other two are Diosgyor Gepgyar in Diosgyor and Esztergom Szerszamgepgyar in Esztergom.

Current trends in the industry include modernization of models to include such features as electronic measuring devices and programed controls and the designing of standardized subassemblies for use in a variety of individual models. The latter trend is considered by the Hungarians as a step toward the future assembly of certain machine tools on conveyor lines. At present, all Hungarian machine tools are assembled in batches.

\* Following on p. 32.

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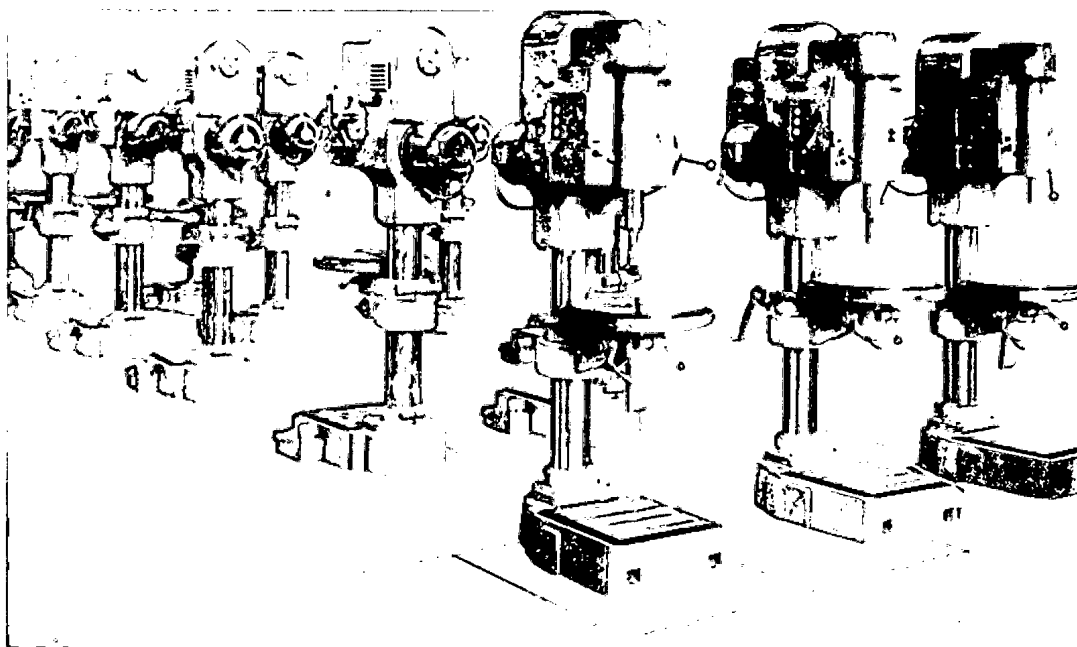


Figure 19. Hungary: Drilling Machine (Upright, Round-Column Type)

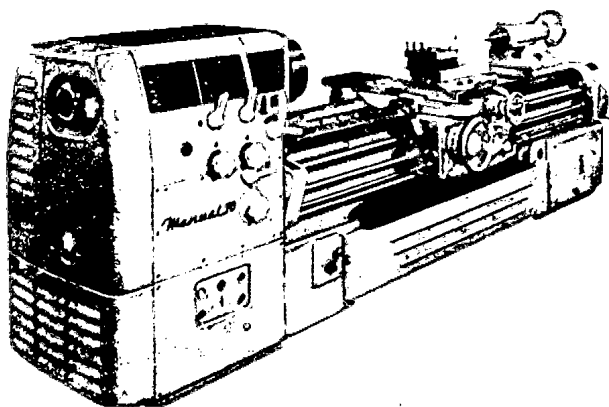


Figure 20. Hungary: Engine Lathe (1960 Model)

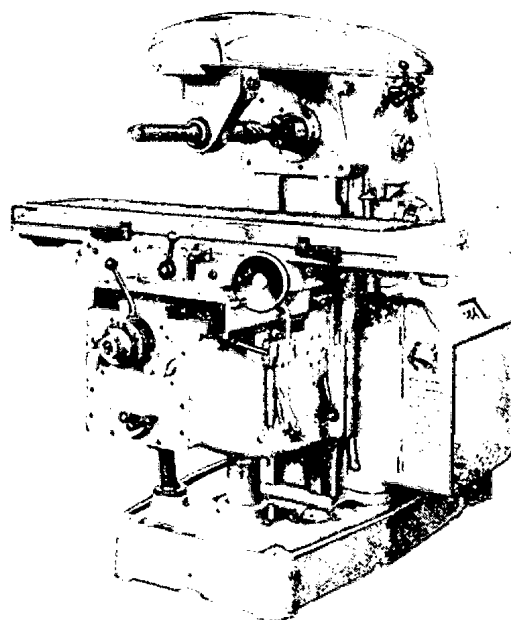


Figure 21. Hungary: Milling Machine (Universal, Horizontal, Knee Type)

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Hungarian exports consist of engine lathes, drilling machines, and milling machines. These categories, which accounted for more than 86 percent of the machine tools manufactured in Hungary during 1950-59, also accounted for more than 80 percent of the exports during the same period. In recent years, more than 60 percent of the exports of machine tools have gone to Bloc countries, about 20 percent to the underdeveloped countries of the Middle East, and the remainder to Western Europe and South America, and the share going to Bloc countries is steadily increasing. Most of the export models are technically equal only to second-grade Western machines, and sales outside the Bloc generally can be made only at prices as much as 40 percent lower than those for similar types of Western machine tools. In addition to exporting machine tools, Hungary has exported machine tool technology. Hungarian engineers were assigned to North Korea during 1956-59 to supervise the construction and outfitting of a machine tool plant with an estimated annual capacity of 3,000 machines.

Because Hungary does not manufacture a complete line of machine tools, it has imported almost all of its metalforming machine tools and many of its automatic lathes, grinders, gear cutters, jig borers, planers, and planer-millers. Principal suppliers are the USSR, Czechoslovakia, and East Germany, and, to a much lesser extent, West Germany and Switzerland.

F. Rumania

Rumania, with a reported production of 4,365 machine tools in 1960, is the smallest producer of machine tools, except for Bulgaria, among the European Satellites. Production of machine tools in Rumania is limited mostly to general-purpose engine lathes, milling machines, upright drilling machines, and shapers. Metalforming types consist solely of small mechanical presses and forging hammers. Almost all models of these machine tools are copies of older Soviet or Czechoslovak designs (see Figures 22 and 23\*). A few prototypes of more complicated machines have been made, but Rumania has not yet attempted to build them in significant numbers. Most production models are obsolescent, and workmanship is poor by Western standards.

Rumanian machine tools are produced in six plants. Three of these plants are general machine building factories or metallurgical combines with machinery departments, and the other three are specialized plants in which machine tools are the chief product. Two of the specialized plants, the Iosif Ranghet Machine Tool Plant in Arad and the Infratirea Machine Tool Plant in Oradea, account for at least two-thirds of the total output of machine tools.

\* Following on p. 34.



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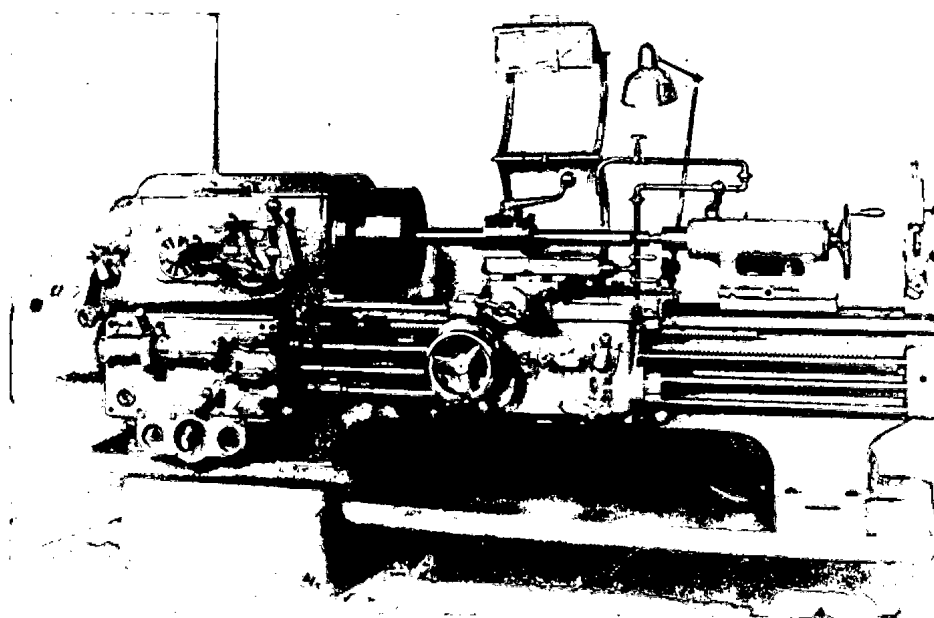


Figure 22. Rumania: Engine Lathe of Soviet Design Being Produced in Rumania

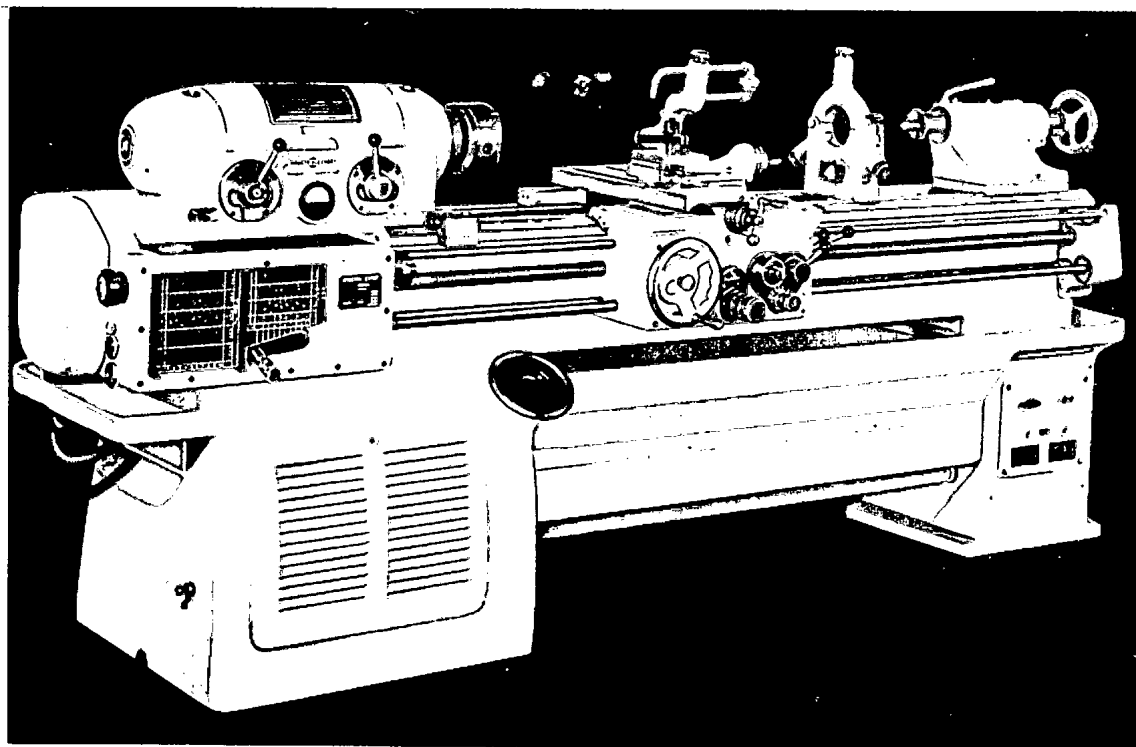


Figure 23. Rumania: Engine Lathe of Czechoslovak Design Being Produced in Rumania

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Further expansion of production of machine tools, including an increased number of models, is planned. By 1965, output is scheduled to reach 7,500 to 8,000 units. This goal, to be attained mostly by retooling and modernizing the existing plants, appears to exceed the technological capabilities of the industry.

Rumania is a net importer of machine tools, having imported more than 1,100 machine tools in 1959, a substantial increase above 1958, when about 600 machine tools were imported. The USSR has been the principal supplier, with smaller numbers being supplied by other European Satellites and by several Western European countries. Exports in 1959 amounted to 10 to 15 percent of domestic production. At least one-half of these exports went to Communist China, and most of the remainder to India and the United Arab Republic. According to a trade agreement in 1960, Rumania was to export to Italy machine tools valued at US \$50,000.

#### G. Bulgaria

Bulgaria, the smallest producer of machine tools among the European Satellites, manufactured 3,000 machine tools in 1960, about 90 percent of which were engine lathes and drilling machines. Output of drilling machines included some hand-feed models. The metalcutting machine tools produced in Bulgaria are limited to general-purpose types and include lathes (with normal swings up to 16 inches), drills (with hole diameters up to 1.5 inches), and shapers (with strokes up to 20 inches). With the exception of the S-9 and S-11 lathes (see Figure 24),

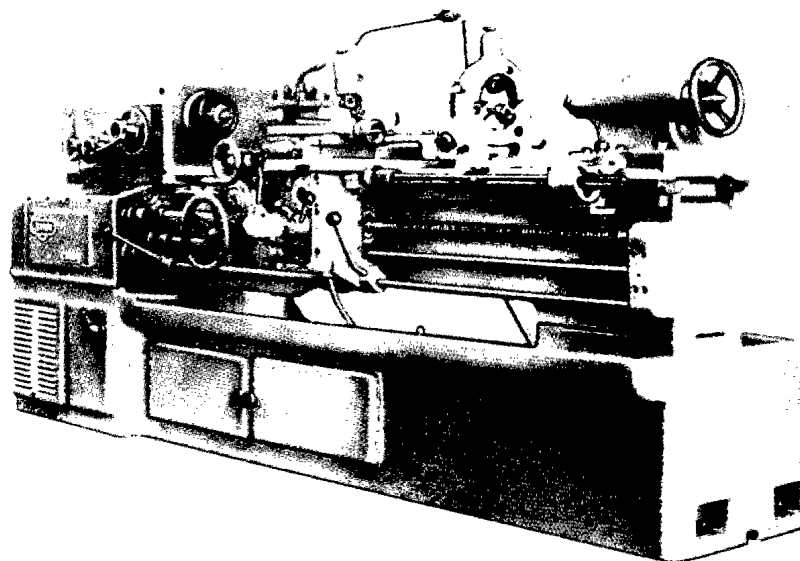


Figure 24. Bulgaria: Engine Lathe (Model S-11),  
One of the Best Models Built in Bulgaria

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Bulgarian metalcutting machine tools are obsolete by Western standards. Production of metalforming machine tools is not significant and is limited to small air hammers and presses up to 60 tons pressure.

Bulgarian plans call for an output of metalcutting machine tools in 1965 valued at four times that of 1957, meaning a production of about 7,000 units -- too ambitious a goal for this rudimentary industry.

The Metalcutting Machine Plant in Sofia, employing almost 3,000 persons, accounts for about 80 percent of output of metalcutting machine tools; most of the remainder is produced at the Spartak State Machine Building Plant in Burgas. Metalforming machine tools are produced at the Vasil Kolarov Machine Building Plant in Sofia and the Nikola Yonkov Vaptsarov Machine Building Plant in Pleven.

Research and development are the responsibility of the Scientific Research Institute for Machine Building and Metalforming in Sofia. This institute has recommended that the Metalcutting Machine Plant in Sofia develop aggregate machines for use in automatic lines. By 1965, according to current plans, aggregate and special machines should constitute about 15 percent of the total Bulgarian inventory of metalcutting machines.

All imports of special-purpose and large-size machine tools come from the Bloc, with the exception of a few specialized metalcutting tools and medium-size presses that have been imported occasionally from non-Bloc countries. East Germany is the major supplier of forging and pressing machines, and during 1958-59 about one-half of Bulgaria's imports of metalcutting tools came from Czechoslovakia. About one-third of Bulgaria's annual output has been exported, chiefly to Communist China, the smaller Bloc countries, and countries of the Middle East.

H. Council for Mutual Economic Assistance (CEMA)

None of the European Satellites produces machine tools in a sufficiently wide range of type-sizes to fill its domestic requirements. Czechoslovakia and East Germany have the capability for this production, but they choose to limit the variety of types produced. Consequently, each European Satellite either must rely on intra-Bloc trade or must import from the West machine tools not produced domestically.

During the early 1950's, there was much overlapping of production, as identical type-sizes of general-purpose machine tools were produced by the various European Satellites. This situation developed because the older producers of machine tools -- Czechoslovakia, East Germany, and Poland -- continued after World War II to produce types for which each was historically noted, while new producers such as

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Bulgaria and Rumania were attempting through domestic production to fill their own requirements for general-purpose types. Each country had ambitious plans for further expansion of its product mix of machine tools. Since 1955, however, this strong movement toward autarky has been arrested and replaced by a gradual trend toward coordination of production among the European Satellites. Much of this coordination has been effected through CEMA, of which all the European Satellites as well as the USSR are members. A number of agreements have been reached in CEMA, which, when implemented, will reduce considerably duplications in production of identical types of machine tools in the European Satellites. These agreements specify which of the Satellites will drop or continue production when machine tools of identical types are being produced by more than one country. Production assignments generally are made to the country with the best existing capability for producing a particular type. Occasionally assignments are based on the need for expansion of the engineering industry in a particular country. The following are examples of agreements made, presumably under the auspices of CEMA, to coordinate production of machine tools in the European Satellites:

1. East Germany is to cease production of horizontal boring mills with spindles larger than 8 inches and concentrate on sizes up to 8 inches. In addition, East Germany is to fill the requirements of European Satellite countries for jig borers. By the end of 1963, East Germany is to cease production of 291 models of metalcutting and metalforming machine tools and is to begin production of 125 new types with emphasis on those that are program controlled. Of the new types, 42 models will be produced for the anti-friction bearing industries of CEMA countries.
2. Czechoslovakia is to produce horizontal boring mills with spindles larger than 8 inches and 10 new models of machine tools for the antifriction bearing industries of CEMA countries.
3. Poland is to produce special machines to be used in production and maintenance of wheels for railroad cars and 12 models for production of antifriction bearings.
4. Hungary is to cease production of slotters.
5. Rumania is to cease production of large lathes and concentrate on smaller sizes.

Specific evidence on the implementation of these agreements is lacking. There is some indirect evidence, however, of coordination of production of machine tools among the European Satellites. Hungary has discontinued production of rise-and-fall milling machines. East

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Germany has not undertaken the previously planned production of large horizontal boring mills. The latest (1961) Czechoslovak catalog of machine tools indicates that certain models have been dropped from the production schedule and that replacements for these particular types must be obtained through imports. Furthermore, of more than 50 models scheduled to go into production in the period up to 1965, 10 have been abandoned in favor of other producers. There is evidence that the principal models of Bloc machine tools have been rated for purposes of making production assignments among member countries of CEMA, and in some instances models from European Satellite countries were rated higher than comparable types produced in the USSR.

Further developments in the area of Bloc coordination can be expected in the future, and this coordination should result in a saving of engineering skills and plant capacity as greater specialization develops. It is unlikely, however, that coordination of production will be carried to such an extent that there will be only a single producer of a particular type of machine tool in the area covered by CEMA.

#### IV. Communist Far East

##### A. Communist China

Communist China claimed production of 90,000 machine tools in 1960, but it is estimated that only 38,000 machine tools of significant types comparable with those produced in other countries of the Sino-Soviet Bloc were actually produced. The remainder were primitive types of machine tools produced by native industry and are useful primarily for the maintenance of machinery that is not built to close tolerances (see Figure 25\*).

Communist China produces a few models of every basic type of general-purpose metalcutting machine tool, but lathes and milling machines predominate, covering 80 percent of the domestic requirements for such machines. The quality of the machine tools produced ranges from good in the long-established industrial areas to poor in the new production centers. Most models are obsolescent by Western standards.

New plant capacity has been built for production of large machine tools such as planers 6 feet wide, vertical boring mills with tables 10 feet in diameter, and 3,000-ton hydraulic presses, but serial production of these machines has not yet been started (see Figures 26 and 27\*\*).

\* Following on p. 39.

\*\* Following on pp. 40 and 41, respectively, below (text continued on p. 42).

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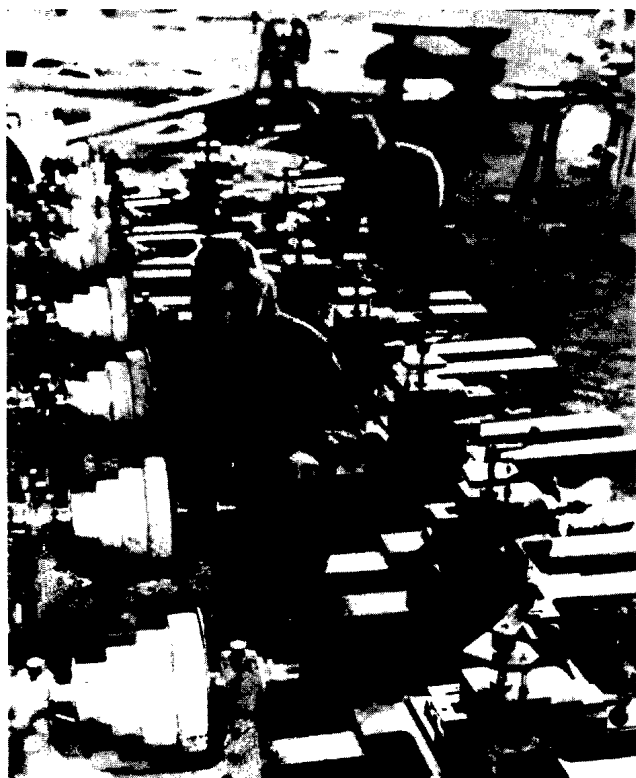


Figure 25. Communist China: "Primitive Types" of Engine Lathes Still Being Built in China

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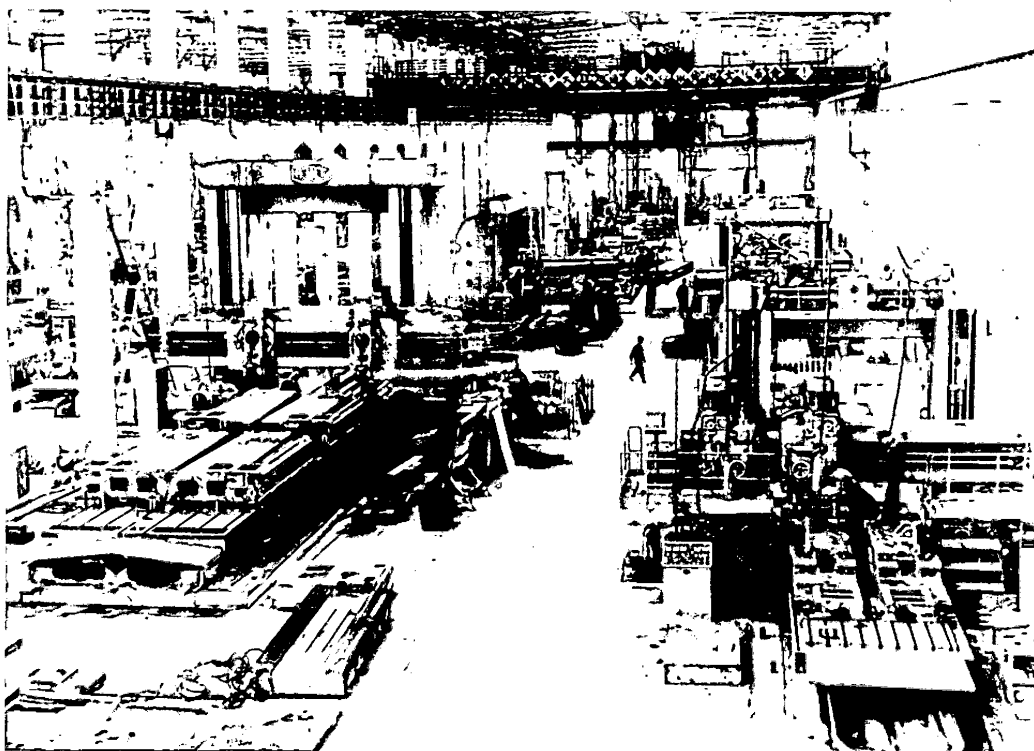


Figure 26. Communist China: Interior View of the Planer Department of the Wu-han Heavy Machine Tool Plant

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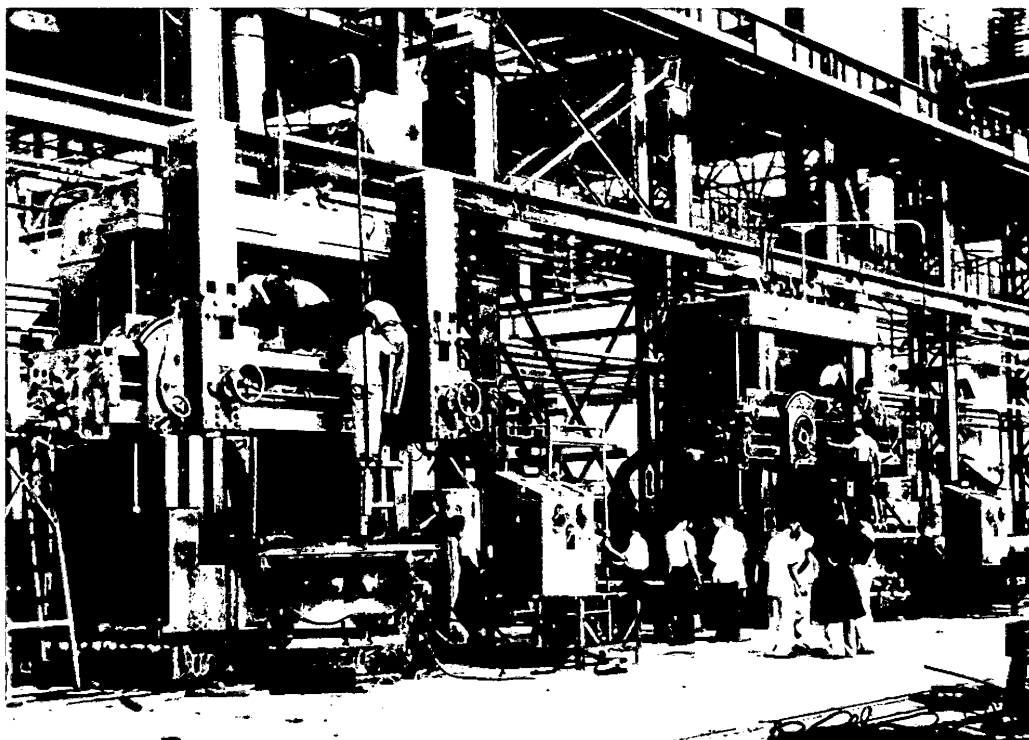


Figure 27. Communist China: Assembly of Vertical Boring Mills with Tables 10 Feet in Diameter at the Wu-han Heavy Machine Tool Plant



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During 1961 the industry built prototypes of more sophisticated and precise machine tools, including an optical profile grinder for production of tools and dies, a grinder for production of spiral bevel gears, multispindle automatic lathes, and a Lindner-type jig-boring machine (see Figures 28 and 29). All of these machine tools are copies of modern foreign models, and some are suitable for incorporation in automatic lines.

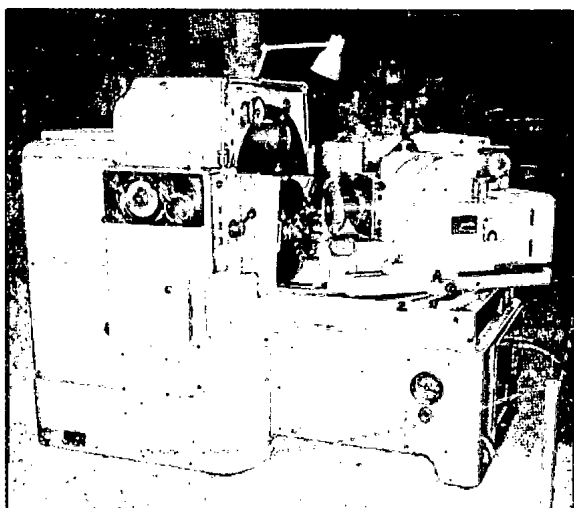


Figure 28. Communist China:  
Hypoid Gear Generator

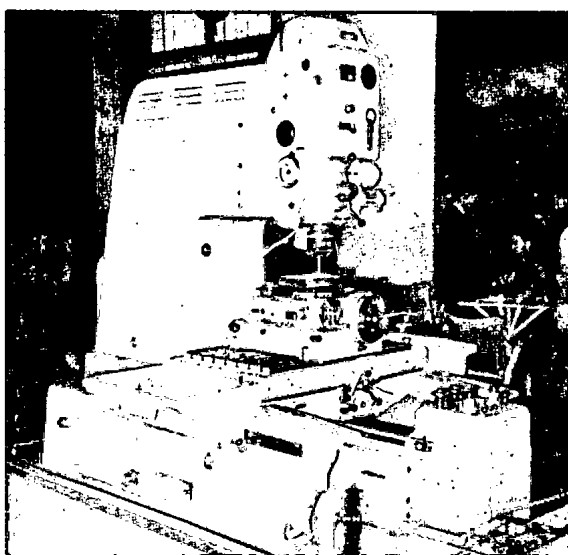


Figure 29. Communist China:  
Jig Borer (Lindner Type)

The USSR and, to a much lesser extent, Czechoslovakia and East Germany have provided most of the technical aid for the Chinese machine tool industry. This aid has included plant layout, production processes, and design of machine tools. The USSR provided all of the manufacturing techniques for the Shen-yang (Mukden) Machine Tool Plant No. 1, China's most productive machine tool plant (see Figure 30\*). East Germany provided the techniques of production for the Shanghai Machine Tool Plant, and Czechoslovak advisers contributed their services to other machine tool plants. The Chinese have not copied the conveyor-line assembly methods employed in some Soviet machine tool plants. Instead, they assemble their machine tools in batches of 10 or more similar units.

About 23 plants in Communist China are significant producers of machine tools, and an even larger number of smaller plants manufacture other equipment in addition to machine tools. About 68 percent of production in 1958 was concentrated in the coastal provinces,

\* Following on p. 43.

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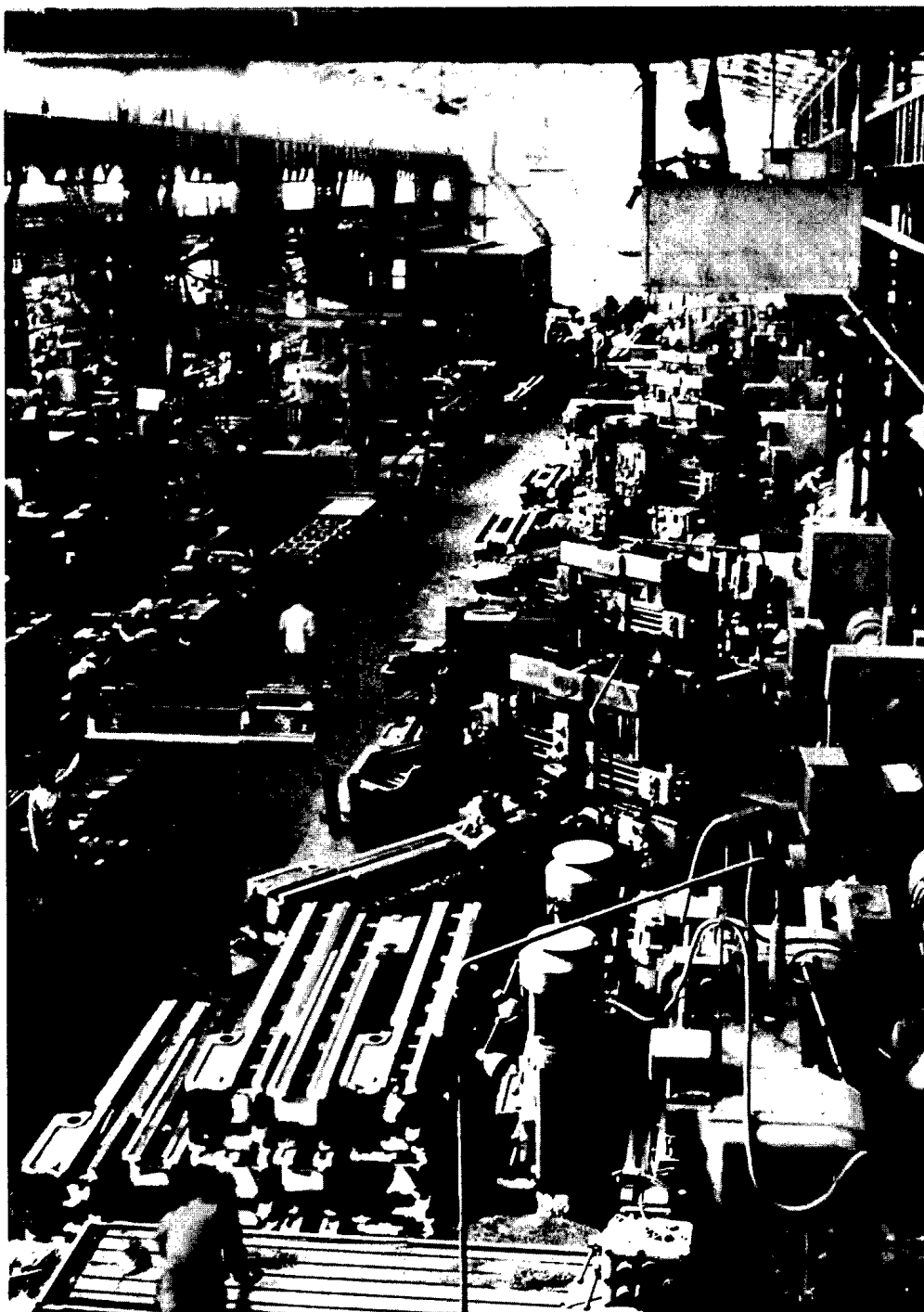


Figure 30. Communist China: Machine Shop of the Shen-yang  
(Mukden) Tool Plant  All equipment in this shop is  
of Soviet design.

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Shen-yang and Shanghai being the principal centers of production. The government has attempted to shift this concentration of production by building new plants in the interior of the country.

A metalcutting machine tool institute attached to the First Ministry of Machine Building has been reported. Machine tool plants, technical schools, and universities also are undertaking research and development in machine tools, with emphasis on development rather than research.

Communist China is heavily dependent on imports to satisfy its requirements for special-purpose and very large general-purpose machine tools. More than 90 percent of these machine tools are imported from the Bloc, but imports from West Germany, the UK, and Switzerland are increasing. Imports in 1959 are estimated to have reached 6,000 units, most of which were more productive than domestically produced models. Chinese exports of machine tools are not significant, although a few have found markets in underdeveloped countries.

B. North Korea

As a result of Soviet Bloc assistance following the outbreak of the Korean conflict, North Korea established a small machine tool industry that by 1961 was approximately equal in size to that of Bulgaria. The production of 2,600 machine tools that was achieved in 1960 consisted of medium-size and small-size general-purpose lathes, milling machines, and drilling machines, all of which were copies of Soviet, Czechoslovak, and Hungarian models.

Two plants specialize in production of machine tools, and a third is under construction. An underground plant in Huich'on was begun during the Korean conflict and completed with Soviet technical assistance and equipment. Since 1956 this plant has been expanded and reequipped with Czechoslovak assistance and in 1961 was producing lathes, radial drills, and milling machines of Czechoslovak design. The maximum capacity of this plant is estimated at 2,000 units annually. During 1956-59, Hungary built a machine tool plant in Kusong with a capacity estimated at 3,000 units per year of table-type milling machines, bench lathes, bolt-threading machines, and a few small presses. In 1959 the North Koreans began constructing a machine tool plant in Pyongyang without foreign assistance. This plant, which was not yet completed by the end of 1961, is a duplicate of the machine tool plant at Huich'on. In addition to the production of these three plants, a few machine tools of very large size, mostly metalforming types, can be produced on special order in heavy machine building plants.

During 1954-56, under an assistance program for rebuilding its industry, North Korea imported significant quantities of machine tools

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from the USSR, East Germany, Poland, and Hungary and token quantities from Rumania and Czechoslovakia. Since 1956, most of the imports have come from Czechoslovakia and Hungary in connection with equipping the machine tool plants in Huich'on and Kusong.

The only known significant export of North Korean machine tools consisted of about 100 engine lathes, with a swing of 24 inches, which were shipped to Communist China from the Huich'on plant in 1960.

C. North Vietnam

Production of machine tools in North Vietnam, estimated at 750 units in 1960, is limited to the Hanoi Engineering Plant, which was completed in 1958 with Soviet assistance. This plant produces a narrow range of light metalcutting machine tools, such as engine lathes with a swing of 12 inches and upright drill presses.

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